SCIENTIFIC AMERICAN

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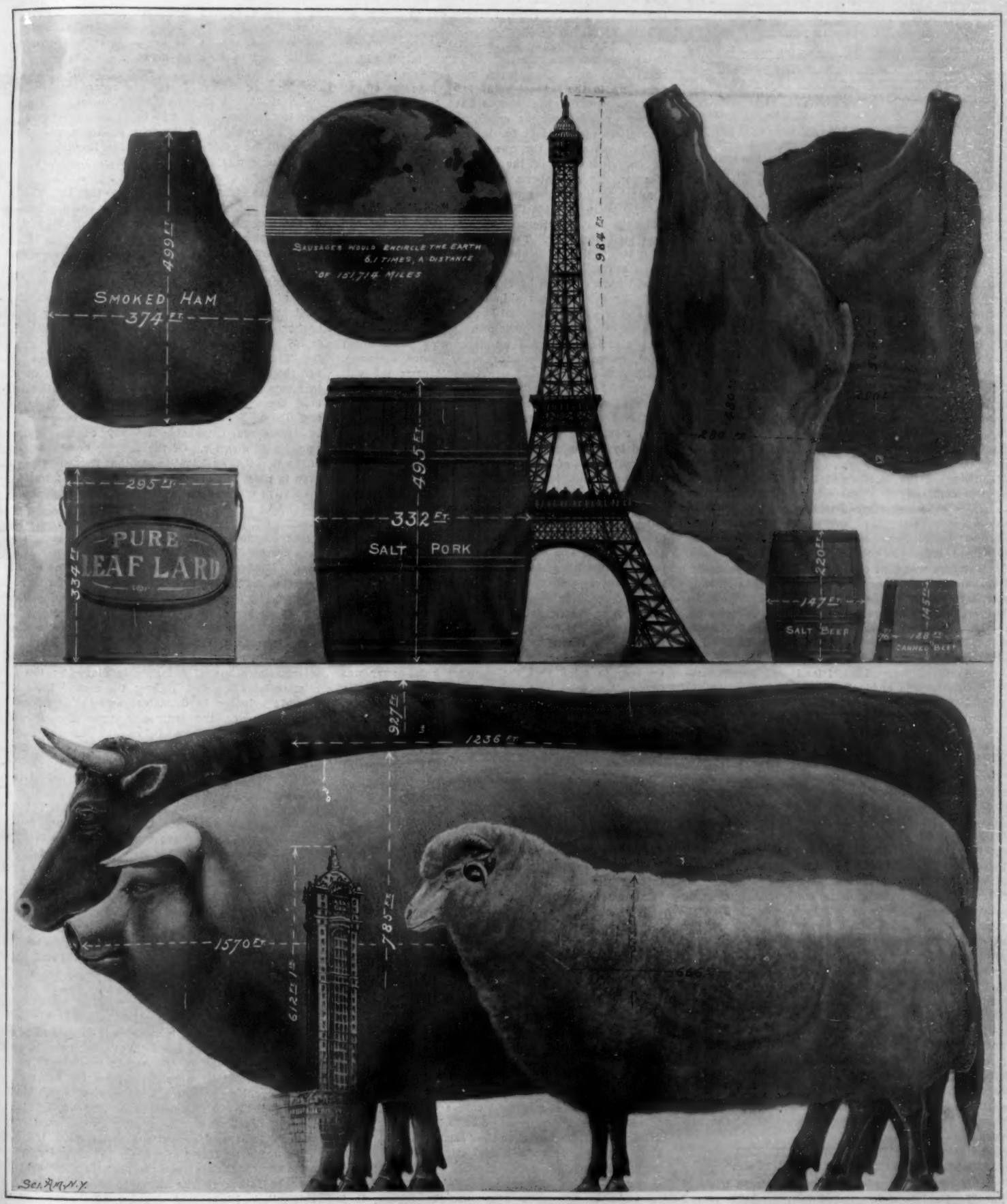

The Slaughtered and Packed Articles.

The Animals on the Hoof.

7,147,835 Beeves. 80,977,639 Hogs. 10,875,339 Sheep.

A GIANT INDUSTRY.—THE MEATS WE EAT.—[See page 185.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, AUGUST 24, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE QUESTION OF TWO ENGINEERS IN THE CAB.

There have been of late so many cases of the sudden disablement of the engineer at the throttle, thereby leaving the train without control, as to lead to a renewed discussion of the question of placing two engineers in the cab, at least on the more important fast trains. Cases have occurred where a train, after the disabling of the engineer, has run for many miles before the accident was discovered. The peril of such conditions is too obvious to call for any comment. That the danger is not so infrequent as to be negligible, is suggested by the fact that our esteemed contemporary, the Railway and Engineering Review, in a recent editorial drew attention to three serious cases of this kind, which had occurred within the previous two or three weeks. The first of these was a collision on the Mobile and Ohio Railroad, caused by the engineer of a passenger train falling unconscious at his post. The train ran past a station where a stop should have been made, and the fireman did not discover what had happened in time to stop the train before it collided with a switch engine. Another case was that of the engineer of a passenger train on the Lake Shore and Michigan Southern Railway, who was overcome by heat and fell unconscious as the train was approaching Cleveland. Fortunately, in this case, the fireman observed the engineer's condition in time to prevent an accident. Mention is also made of the case of an engineer on a freight train on the Chicago, Rock Island, and Pacific Railway, who became suddenly insane and persisted in running his train at full speed in spite of the efforts of the fireman to prevent it. The above cases are only typical of many which are continually recorded in the daily press. There was a time, in the days of smaller locomotives, when the fireman had more leisure than now for general observation, both of the signals and of conditions in the cab. He was in closer touch with the engineer. To-day, however, the locomotives have increased to such large dimensions, that the attention and energy of the fireman are fully occupied in keeping the huge furnaces fully supplied with fuel, and the boiler with water. Not so very many years ago 2,000 square feet of heating surface was the maximum to be found on most of even the largest engines; but to-day the standard express passenger engine will have from 2,500 to 3,500 square feet of surface, and the most powerful freight locomotives from 4,500 to 5,500 square feet. From personal experience when riding in the cab of fast and heavy passenger trains, we know that what time the fireman is not shoveling coal, he is attending to his injector or peering ahead for the first glimpse of the signals. It is our conviction that locomotives have grown to such a size, that the railroad management should give careful consideration to the question of placing a third person in the cab of the largest engines for purposes of observation, and this is particularly necessary on those locomotives in which the engineer's cab is separate from that of the fireman.

STEAM TRIALS OF THE "LUSITANIA."

Later advices regarding the official steam trials of the "Lusitania" show that this remarkable vessel made even higher speed than she was credited with in the earlier reports. On the measured mile she steamed at 26¼ knots, and on the forty-eight-hour deep-sea trial, over a measured distance of 1,200 knots, she maintained a mean speed of 25.4 knots. As the conditions of the sea trial were practically identical with those which ordinarily obtain on a transatlantic trip, she should easily maintain an average speed, as called for by the contract with the British government, of 24.5 knots on a round voyage across the Atlantic. The 300-mile course for the deep-sea trial was laid between the Corsewall Light on the coast of Scotland and the Longship Lighthouse at Land's End. This was covered four times, the vessel making two runs to the north and two to the south. On both of the night runs there was a northwesterly wind, which freshened to considerable strength, and its effect was shown in the recorded speeds. On the first southerly course from Scotland to Land's End, the average speed was 26.4 knots. Returning, the average was 24.3 knots; on the second southerly trip it was 26.3 knots, and the final 300 miles was covered at 24.6 knots, the mean speed, therefore, working out as 25.4 knots for the whole 1,200 miles.

This was certainly an exceptional performance. Trial trips are usually associated in our minds with a short dash over a measured mile, with everything keyed up to the highest point for a supreme effort; and consequently, trial speeds have come to possess merely an academic or spectacular interest, useful as matters of record or for their effect in the advertising literature of the owning company, but giving no sure indication of the day-by-day service of the steamer. To all intents and purposes the trial of the turbine liner was a service test, both in time, distance, and in the fact that the regular routine methods of a transatlantic trip were followed by the officers, staff, and crew. Therefore, that the "Lusitania," with her engines absolutely new, and the staff necessarily unfamiliar with the ship and its motive power, should have exceeded by two knots an hour the speed made by any previous ship over the same distance, marks her as a phenomenal boat, and raises a reasonable expectation that during the present season the transatlantic record will be placed at a point which must necessarily stand for many years to come. Neither the "Lusitania" nor the "Mauretania" will prove to be the first "four-day" boat, but they are likely to bring the record down to four days and a half, and possibly a little below that.

To marine engineers the most significant fact, as stated by our esteemed contemporary Engineering, is that every unit of the machinery should have worked throughout this long trial with uninterrupted mechanical precision. The air pressure in the ash-pits at the boilers did not, at any time, reach the maximum of ¾ of an inch prescribed in the specifications by the Cunard Company. With a boiler pressure of 186 pounds, the pressure at the receiver of the high-pressure turbine varied little from 150 pounds. The mean vacuum was 28.2 inches, and the mean revolutions of the four shafts were 188 per minute. The horse-power, determined by that ingenious but we fear not very reliable device, the "torsionmeter," which determines the torque by the amount of twist of a given length of the shaft, was 64,600 horse-power. When we bear in mind that the contract horse-power was 68,000, it will be seen that the accomplishment of a greater speed with 3,400 less horse-power (if the torsionmeter was correct) is full of promise for further high-speed performance.

"CECILIE": THE FASTEST RECIPROCATING-ENGINE LINER AFLOAT.

The arrival at the port of New York of the transatlantic liner "Kronprinzessin Cecilie," of the North German Lloyd Steamship Company, marks the advent of the last and finest of that great quartette of high-speed ocean steamers of this company, which has helped so greatly to advance the speed and comfort of transatlantic travel. Commencing with the "Kaiser Wilhelm," which was the first ship to maintain an average of over 23 knots an hour across the Atlantic, the company have placed in service at intervals of a year or two the "Kronprinz Wilhelm," with a record of 23.47 knots; and the "Kaiser Wilhelm II.," which raised the speed to 23.58 knots, the present record of the Atlantic. The last-named ship, which was brought out in 1904, proved to be so eminently satisfactory that, when the company decided to build the "Cecilie," they considered that they could not do better than duplicate the "Kaiser Wilhelm II." in every particular. This was done; and that the ship will equal, and probably exceed, the performance of the sister vessel is shown by the fact that on the trial trip, over a measured course of 60 miles, the "Cecilie" averaged a speed of 24.02 knots.

In view of the fact that the "Lusitania" has shown such good results on her trial trip, and is likely to capture the Atlantic record, and that the German Lloyd Company are certain, in the future, to make an effort to win back the record, it is probable that the "Cecilie" is the last high-speed transatlantic steamer of very great power that will be built with reciprocating engines. In fact, it may be taken that in this ship the German shipbuilders have carried the development of the reciprocating marine engine up to the high-water mark of its possibilities. Further advance will be either along the lines of the steam turbine, or of turbo-motors with the electric motors direct-connected to the propeller shafts; or it may be that the next advance will be marked by the introduction on a large scale of the marine producer-gas engine. That the limits of the reciprocating engine have been reached, is shown by the great magnitude attained by many of the engine parts, and notably by the propeller shafts. These last in the "Cecilie" are 25¼ inches in diameter, and upon each devolves the heavy duty of transmitting at times as much as 24,000 horse-power. This is an enormous load to be imposed, day and night for nearly a week, upon a single member, and the question of further increase of power is halted by the serious difficulties that would be encountered in the forging of shafting of the necessary size, elasticity, and durability. For this reason alone, naval designers are being driven to the use of three and even four shafts; and to such an arrangement the steam turbine lends itself perhaps more readily than the reciprocating engine. In the new record-breaking ship which the North German Lloyd Company are pretty certain to undertake, it will be a question of great interest as to which of the four leading types of turbine will be adopted—whether the English Parsons, the American Curtis, the German Zoelly, or the French Rateau.

If we are right in our conjecture that the "Cecilie" will mark the highest point to which the development of the reciprocating engine will be carried in high-powered steamers, the "Cecilie" and the sister ship will always be notable landmarks in the future annals of the marine engine. They have set the figures for fuel economy at a point which must ever tax the skill of the steam turbine builders to surpass, if indeed they ever attain it. Before giving any details of the motive power, we may mention that the "Cecilie" is 706 feet long, with a beam of 72 feet, a depth of 44 feet 2 inches, and a displacement of 26,000 tons. She has the usual double bottom, and the hull is divided into twenty water-tight compartments. All the bulkhead doors may be closed directly from the bridge; and like all modern liners of the first class, she may be considered unsinkable by any of the ordinary agencies of disaster. Of the interior accommodations of the ship it is sufficient to say that they are superior, even to those of the later ships of this line; while the decorative features are marked by the simplicity and refinement of the latest school of marine decorative work.

The engines of the "Cecilie" are four in number, each carried in its own separate water-tight compartment. Each engine has indicated about 12,000 horse-power in actual service. They are placed in pairs in tandem, two on each shaft. In the four engines there are altogether sixteen cylinders—four high-pressure, four first intermediate, four second intermediate, and four low-pressure cylinders. The high-pressure cylinders, which are carried in tandem over the first intermediates, are 37⅜ inches in diameter; the first intermediates are 49¼ inches; the second intermediates, 74⅞ inches in diameter; and the low-pressure cylinders reach the truly enormous size of 112¼ inches diameter, these being the largest marine cylinders, we believe, ever built. The common stroke is 6 feet. Steam is supplied from nineteen cylindrical boilers, at a pressure of 230 pounds to the square inch, through four main steam pipes, each of which is 17 inches in diameter. To produce this steam 764 tons of coal are burnt every twenty-four hours in 124 furnaces; and, as we have above stated, the resulting 48,000 horse-power of the main engines has proved sufficient to drive the vessel at slightly over 24 knots an hour.

It is an interesting coincidence that the latest, and what will probably be the last, of the reciprocating-engine liners, should be placed in service at about the same time as the first of the new high-speed turbine liners. The performance of these two ships will naturally be watched with the keenest interest; for in spite of the fact that the turbine-driven ship greatly exceeds the other in size and power, the "Cecilie" herself, with her displacement of nearly 30,000 tons, and her horse-power of nearly 50,000, is sufficiently large and powerful to eliminate, when driving into a head sea, much of the advantage due to the higher momentum of the larger ship. It is to be hoped that the facts as to relative coal consumption will be made available for the technical world. Just now, the steam turbine is being saddled with a reputation for extreme costliness in fuel; and predictions along these lines are being made so freely regarding the new Cunarders, as to suggest that perhaps the wish, in some quarters, may be father to the thought. For ourselves, we think it is likely that, because of the size of the plant and the high speed at which the turbines are being run, the new Cunarders will show about the same economy as the latest reciprocating-engine ships. This has been brought down in the "Cecilie" to 1.4 pounds of coal per horse-power per hour, including the auxiliaries.

GOVERNMENT FUEL TESTS AT JAMESTOWN.

The government fuel-testing plant, which for two years was in operation at St. Louis, has been moved by the order of Congress to Norfolk, where it has been located near the main entrance to the Jamestown exposition. In the course of the work done at St. Louis, the United States Geological Survey in charge of the plant showed that by more economical methods of burning the coal, it would be possible to make a saving of ten per cent of the total coal consumption of the country each year, an amount which would represent a saving in value of $160,000,000 annually. The work now to be undertaken at the testing plant will be devoted, first, to increasing efficiency and so preventing waste of the fuel resources of the country, and secondly to the testing of coal used by the government, particularly on warships. Under the first head, the most valuable tests will be those made to determine the relative efficiency of the steam boiler and the gas producer. Already it has been demonstrated at this plant that the gas engine is capable of producing over 100 per cent more work from a pound of coal than can be secured from the average steam engine. Experiments in this connection will be continued with the 235-horse-power internal-combustion engine which forms part of the plant. It is to be supplied with gas made in two producers from the same grades of fuels that will be used in the boilers. It is proposed to make in this way comparative tests of the poorer fuels, such as slack coals, culm, lignite, and peat. Particularly valuable to steam users will be the result obtained by the engineer in charge of the steam division of the plant, Prof. L. P. Breckenridge, who has already succeeded, or practically so, in separating the results obtained in the boiler from those obtained in the furnace; and particular attention is to be paid to the efficiency of the furnace alone. Exhaustive tests will be made to determine what conditions are necessary to burn these low-grade fuels without smoke, and the lessons learned will be valuable, not only from the standpoint of economy, but also as tending to abate the ever-present smoke nuisance.

In its work of testing fuels for the navy, the testing plant will have at its service three briquetting machines; one of German make, which will be used for briquetting the lignites of Texas and the Northwest; another an English machine, which has already been in use at the plant in St. Louis; and also an American-made machine. Although the advantages of briquetting have been thoroughly understood for many years in Europe, this form of fuel has not received the attention it deserves in the United States; and it is hoped that the work of the testing bureau on American coals will prove that briquetting will give as good, if not better, results than are obtained from lump coal taken from the same mine as that from which the coal for the briquettes is secured. For the navy, the briquette should prove especially useful; for it is practically smokeless, and concealment and invisibility are most important factors in the strategy of war. It will probably be shown in the forthcoming tests, that in locomotive boilers or marine boilers using any forced draft system, the use of the coal in briquette form so largely increases its efficiency as to more than offset the cost of briquetting.

Other tests, which should yield valuable results, will be made with five 15-horse-power gasoline engines, which have been erected at the plant for the purpose of testing the relative efficiency of gasoline, kerosene, denatured alcohol, and other liquid fuels, in the production of power and light. Finally, an investigation will be made to determine the exact cause of the spontaneous combustion of stored coal, and upon the results obtained recommendations will be made as to the best methods of storing.

THE 24-HOUR AUTOMOBILE RACE ON THE BRIGHTON BEACH TRACK.

Since it has been decided that there will be no Vanderbilt Cup or other big road race this year, interest has centered chiefly in the new form of track race—the 24-hour event. Several of these races have been held on race tracks at various places, the latest and most successful one having been run off on the Brighton Beach track on the 9th and 10th instant. Fifteen machines started in this race, as follows: A 60 horse-power Thomas, 40 horse-power Lozier, Jackson, and Mitchell cars, a 50-horse-power Darracq, a 45-horse-power Delahaye, 35 and 28 horse-power Oldsmobiles, a 28-32 horse-power Pilain, a 35-horse-power Stoddard-Dayton, 40-horse-power Matheson, 50-horse-power De Dietrich, Welch, and Frayer-Miller cars, and a 60-horse-power Lozier. With two exceptions—the Thomas and the De Dietrich—two drivers were provided for each car, one to relieve the other. The race was started at 10:20 P. M. Within the first hour, several cars were obliged to stop to light their red tail lights. Much trouble was experienced from these lights going out during the night hours of the contest. The De Dietrich, after making a round on three cylinders, pulled into the center of the oval and renewed a blown-out gasket on its engine. This car had considerable trouble from this cause. The tire repair stations within the oval were early called upon. The Stoddard-Dayton was kept waiting for nearly four hours as a result of tire trouble and a demolished rim. It was finally withdrawn after 16 hours, during which it covered 216 miles.

Other cars that were soon obliged to drop out were the 60-horse-power Lozier, the Frayer-Miller, the De Dietrich, and the Pilain. The first two, owing to a sharp turn in a soft spot (which caused the tie rod connecting the front wheels to break) and the bursting of a front tire respectively, ran through the fence and were damaged sufficiently to put them out of the race; while the two French cars quit after cracking two cylinders and demolishing a front wheel. The latter accident caused the Pilain to run through the inner fence and injure a number of spectators who were sitting thereon. In less than three hours the car was running again, but on account of a cracked frame it was ruled off the track. It covered 219 miles, while the De Dietrich covered 311. Both were withdrawn at the end of the ninth hour. The Frayer-Miller (which was the sole representative of the air-cooled cars) covered 268 miles in 6 hours and was in first place at the time of its accident. The Lozier covered 104 miles in 3 hours before it dropped out. From the end of the sixth to the end of the twenty-third hour the Jackson led, with the Thomas second and the 40-horse-power Lozier third. During the last hour of the race, the Jackson had trouble with its timing gear owing to a set-screw loosening. The motor misfired badly and finally stopped. The 60-horse-power Thomas, which had been gaining gradually upon its 40-horse-power rival, then assumed the lead, and finally finished with 997 miles to its credit, while the Lozier had 972, and the Jackson 966. The 40-horse-power Mitchell, which had been doing some very consistent running after experiencing a broken fan and damaged radiator in the first hours of the race, was fourth with a score of 774 miles. Only two other machines, the French Delahaye and Darracq cars, were still in the race at the finish. These cars scored 720 and 560 miles respectively. Each of them experienced various troubles that kept them off the track for long stretches at a time, and neither of them was actually running when the finish occurred.

THE CURRENT SUPPLEMENT.

Tebessa, though not one of the largest, is one of the most interesting towns of French Algeria, chiefly because it is the Theveste of the Romans. Its archæological curiosities are interestingly described and illustrated in the opening article of the current SUPPLEMENT, No. 1651. In an article entitled "Photodynamic Phenomena," Prof. Henry von Tappeiner describes some luminous animals and plants. The first installment of a most thorough treatise by Col. C. W. Larned, of the United States Military Academy, on the history of map making and topography, is published. Heavy freight trains are historically and mechanically discussed. Every student of mechanism knows the difficulties that have been encountered in fully grasping the meaning conveyed by a textbook description of the properties of a particular mechanism, and the effect of altering its proportions. An English engineer has devised an apparatus for overcoming such difficulties. This is called the Newman kinematic apparatus for the study of mechanism, and is described in the current SUPPLEMENT. A new system for laying and fixing rails for street surface railroads is explained by the English correspondent of the SCIENTIFIC AMERICAN. Francis Elgar's excellent paper on unsolved problems in the design and propulsion of ships is concluded. Horace C. Hovey gives a picturesque account of the Mammoth Cave Cathedral. To simplify the mechanical construction of storage batteries, and at the same time to improve their operation and increase their efficiency, is the avowed object of two inventions by Thomas A. Edison, which form the subject of an article in the current SUPPLEMENT. The presidential address before the British Association for the Advancement of Science was delivered by Sir David Gill, who took as his subject the science of measurement and its application to astronomical research. An extensive abstract of this paper appears in the current SUPPLEMENT.

It is reported that President Roosevelt has approved certain suggestions as to new coinage which have been made by the American Numismatic Society, and that he has called for a report from the Secretary of the Treasury. A new coinage of the eagle and double eagle, from designs by the late Augustus St. Gaudens, is already in hand. A strong committee of the Numismatic Society recommends that Congress be petitioned to authorize an entirely new coinage of artistic design, to consist of ten denominations, and in order that the designs of the new coins be truly artistic the best talent in the country should be called upon to submit drawings. The resolutions read: "That the sum of $10,000 be appropriated for each special coin model, without regard to the monetary value of the coin to be issued, whether a cent or a twenty-dollar gold-piece, as it is important to have the smallest coins as artistic as the highest. That the six best designs received for each piece shall be awarded $1,000 each from the above sum of $10,000, and that the committee hereinafter proposed shall have the right to select the best of the six designs, and to accept the model with or without modification by the designer, paying the successful competitor an additional sum of $4,000."

SCIENCE NOTES.

The sea around Bermuda has long been noted for the wealth of its zoological life. In many of the shallow, clear waters around the coast it is possible for visitors to scan the ocean bottom, where the brilliant coloring of corals, plants, and animals can be plainly seen. A laboratory for biological research has already been established in Bermuda, and its work will probably receive an impetus from an interesting forthcoming visit. The Seventh International Zoological Congress, held in Boston August 19 to 23, has arranged for an excursion to Bermuda in order to give the members of the Congress an excellent opportunity to get a glimpse of this most interesting zoological region and to become acquainted with the manner in which the work is conducted. The local programme of the trip will include several collecting and dredging trips, so that those who go there will have an opportunity to collect and preserve much material.

Archæological work is being carried on in the island of the Nile known as Elephantine, under the auspices of the French government and directed by M. Clermont-Ganneau. This island is situated in the middle of the Nile, not far from the first cataract. Owing to the character of the ground, the work of excavation is somewhat difficult; but a number of objects, some of which are of considerable value, have been found. Among these may be mentioned two large steles of diorite, covered with inscriptions of Thotmes III. A curious kind of sanctuary decorated with miniature obelisks and covering a spot which was used for burying the bodies of sacred animals was also found. These animals proved to be rams, carefully mummified and buried in sarcophagi of granite. The wrappings of the mummies are gilded and ornamented with painted scenes of a mythological character and bear inscriptions. The ram was among the sacred animals of Egypt, and seems to have been specially consecrated to the deity Khnoum, one of the principal deities of the island. Among other finds are many fragments of texts inscribed upon pieces of pottery and known as *ostraca*. The inscriptions are in hieroglyphic, hieratic, demotic, Greek, Arab and Coptic, and there are about a hundred in all. The presence of the Aramean language shows that even as far back as the fifth century B. C. the island was inhabited by the Jews, as also the neighboring locality of Aswan. Papyrus inscriptions had already proved this fact, but now we find just what quarter of the ancient city was inhabited by the colony of Jews; as the *ostraca* are not found anywhere else. According to the records a Jewish temple must have existed in this locality, and the excavators are hopeful of finding it.

From time to time lumps of butter are dug out of the Irish bogs, and specimens of it may be seen in various museums. A chemical examination has recently been made by Messrs. Radcliffe and Maddocks of a sample of such butter, which was found four feet below the surface of a bog at Maghery, county Tyrone. The original lump, which weighed about 20 pounds, is probably some centuries old, and it is suggested that it had been put into peat water to preserve it, or to give it a flavor, and had then been forgotten. Yet so effectually had the fat been preserved by the peat water that it still retained many of the chemical characteristics of butter fat, though naturally its appearance had greatly changed. The exterior was white and granular, and the whole mass had been converted into a wax-like material. The conclusion that it had once been butter, however, was confirmed by the fact that numerous cows' hairs were present. A similar alteration of animal fats when buried in the earth for a long period has frequently been noticed, and the wax-like product is known as "adipocere." The name originated with Fourcroy, who, in 1789, communicated to the French Académie des Sciences the results of his examination of the fat of some of the bodies transferred from the church graveyards to the Catacombs of Paris. The change in the fat was most noticeable in the case of bodies that had been buried about fifteen years and originally crowded together, the bones being then coated with a gray plastic substance. Fourcroy came to the conclusion that this adipocere ("fat-wax") was formed by the slow decomposition of any animal substance, with the exception of bones, hair, and nails; but Chevreul who studied the phenomenon in 1812, showed that only the fat originally present was affected in this way, and his conclusion was confirmed by Gay-Lussac.

OPENING OF THE LARGE DRYDOCK AT LEAGUE ISLAND.

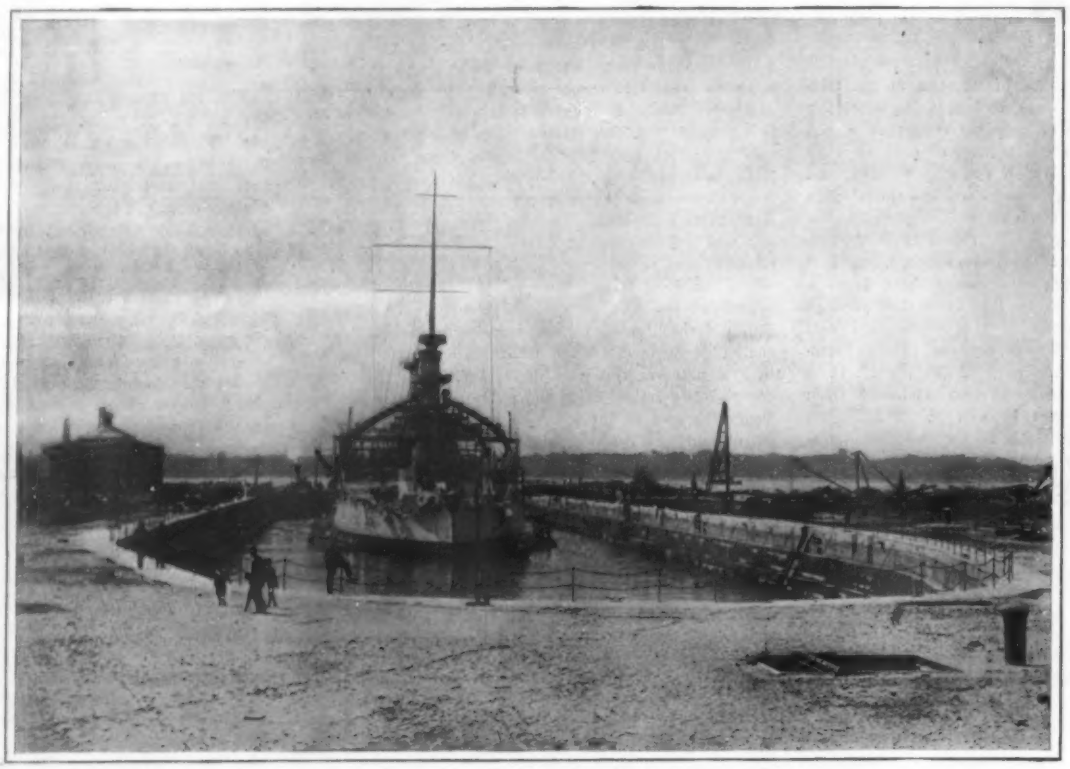
The handsome drydock at League Island, after much delay, has been opened to the nation's warships. So large is this new dock, that although the "Kearsarge," the first warship to be towed into the dock, is 368 feet long, with a beam slightly in excess of 72 feet, she looked far less than her size when the huge basin was empty of water.

The length of the dock over all from the outer groove to the head of the dock is 750 feet; the length of the bottom is 698 feet; and the width amidships is 134 feet. The width at the bottom, amidships, is 80 feet. At the entrance to the basin the width is 102 feet at the top and 80 feet at the bottom. At mean tide the water over the sill is 30 feet deep, a sufficient depth to accommodate the largest battleship afloat.

The basin is built in courses of stone and concrete, narrowing as the bottom is approached. It represents four years of most arduous toil, and the mastering of engineering difficulties that were well nigh baffling. Two or three of the sub-contractors engaged upon the work were forced to suspend, unexpected physical problems arising which made the cost of excavating and building the elementary portions of the basin far more expensive than the government's appropriation would warrant. In constructing this expensive work, quicksand proved to be the most serious difficulty. This necessitated the driving of 4,000 piles to provide a foundation strong enough to prevent the massive superstructure and its loads from serious settlement. With this quicksand in mind, the engineers watched closely the docking of the "Kearsarge"; but even with the weight of the battleship added, the dock stood the test with every evidence of stability.

The walls of the new basin have an unusually steep pitch. This improvement makes possible the floating and docking of the largest war vessels in the basin with less water than would be required by a much smaller structure.

The drydock was authorized by Congress in 1898, at the close of the war with Spain. It is the design of the Navy Department that each of the divisions of the Atlantic squadron shall have its particular drydock; and to League Island have been permanently assigned the "Kearsarge," "Kansas," "Georgia," "Maine," "Brooklyn," "Columbia," "Minneapolis," "Montgomery," "Dixie," "Prairie," "Yankee," and "Panther." The old drydock at the navy yard is large enough to accommodate all except the largest of the battleships.



Length over all, 720 feet. **Width,** 134 feet. **Depth over sill,** 30 feet.

This View Represents the Docking of the Double-Deck-Turret Battleship "Kearsarge."

OPENING OF THE LARGE MASONRY DRYDOCK AT LEAGUE ISLAND.

MAGICAL CURES.

BY RANDOLPH L. GEARE.

From time immemorial people in almost all countries have believed in the curative properties of certain natural objects prepared by special methods, as well as in the supernatural power of images, idols, and fetiches of all kinds. Stones of different qualities have been supposed to possess divine attributes. Elias Ashmole, who styled himself "Mercuriophilus Anglicus," writing in London in praise of alchemy during the middle of the seventeenth century, described several of these stones under the head of "mineral" stone, "vegetable" stone, "magical" or "perspective" stone, "angelicall" stone, etc. The first, he declared, had the power of changing any imperfect earthy matter into gold and silver, flints into rubies, diamonds, sapphires, etc. By means of vegetable stones, men, beasts, birds, fishes, and plants could be made to grow and bear fruit. The magical stone enabled one to discover any person in any part of the world, as well as to understand the language of birds and beasts, while the "angelicall" stone endowed its possessor with divine gifts, causing angels to become manifested, besides conveying the power of conversing with them through dreams and revelations. Even such men as Lord Bacon and Sir Isaac Newton speculated on the so-called philosopher's stone, so that those of our day who visit mediums and believe in rappings and slate writings are no whit more credulous than they. Dr. Christopher Girtanner, a famous professor of Göttingen, prophesied as late as the last century that before it had passed the transmutation of gold would be generally known and practised. "Every chemist and artist," said he, "will make gold; kitchen utensils will be of silver and even gold, which will contribute more than anything else to prolong life, poisoned at present by the oxyds of copper, lead, and iron, which we daily swallow with our food." Perhaps his contention on this point was correct. Who knows?

But fascinating as a glimpse of early beliefs in chemistry and medicine might be, the purport of this article is rather to mention a few of the charms, amulets, or talismans, in the efficacy of which even now millions of the inhabitants of many lands firmly believe. Perhaps there is not one among these groups of objects more curious than the so-called Scythian lamb—or in China the "golden-haired dog" (*Kouchi*)—which is after all nothing more than a woolly root, but was actually esteemed as a drug of marvelous properties by the pharmacists of Europe during the sixteenth and seventeenth centuries, and was believed by reputable physicians to be half plant and half animal. In China it is regarded even now as a supernatural means of renewing youth.

Where magical powers are bestowed through the medium of animals, the former are believed to be increased in proportion as there is mystery in their modes of life. Toads and other batrachians come under this category, and hence lizards which have been dried and neatly stretched upon bamboo splinters, are greatly in demand in China and other countries where the primitive medical man still holds sway. In Japan merely the skin of a snake is still supposed to be a sovereign cure for abdominal pains. Turtles, too, are regarded with great awe in China, and so are tigers' bones and carbonized monkeys' skulls, which are prepared by putting them into clay vessels exposed to heat until the crania are thoroughly calcined. Birds are also carbonized for medicinal purposes, and the nests of certain swallows, made out of the gelatinous substance of seaweeds partly digested and disgorged, are believed in that country to be most invigorating as medicine for the sick.

The Indian medicine-man does not by any means rely wholly on magic for his cures; he makes people well by producing uncanny noises, which are believed to frighten away the spirits of disease. For this purpose a wooden rattle covered with buck-skin, and made up in the shape of a turtle, is often employed, while for similar purposes of exorcism the Tibetan lama wields a whip with a handle of human bone and lashes of human skin, while he beats upon a drum formed out of the upper parts of two human skulls.

Charms and incantations were common among the Druids for the cure of diseases, and often the former consisted of nothing more than rags, old clothes, pins, or needles. In Persia there is a superstition that a patient has only to deposit a rag on certain bushes to obtain a cure. Pieces of garments that have touched the "pilgrim camel" are preserved with great veneration, and when persons are dangerously ill, they lay these things on their bodies as infallible

Sorcerer's Image (Korea) of Stuffed Buckskin.

Indian Medicine Man's Rattle.

MAGICAL CURES.

remedies. Among the Indians and Norwegians, and other northern nations, the hoof of the elk is regarded as a sovereign cure for epilepsy, if applied to the heart of the sufferer and then to his ear. In the Hawaiian Islands a fetich consisting of a human thigh-bone and a braid of human hair is regarded as a panacea to ward off misfortune; while a straw image thrown out of a Korean's house on the last day of the year, is believed in that country to carry with it the sins of the household, as well as to obliterate all traces of bad luck.

Idol at Korean Crossroads, Used to Frighten Away Spirits, Which are Much Dreaded in the East.

The Famous Scythian Lamb—a Woolly Rootstock of a Plant Alleged in Myth to be a Young Sheep. The Plant is Grown in China for Medicinal Purposes.

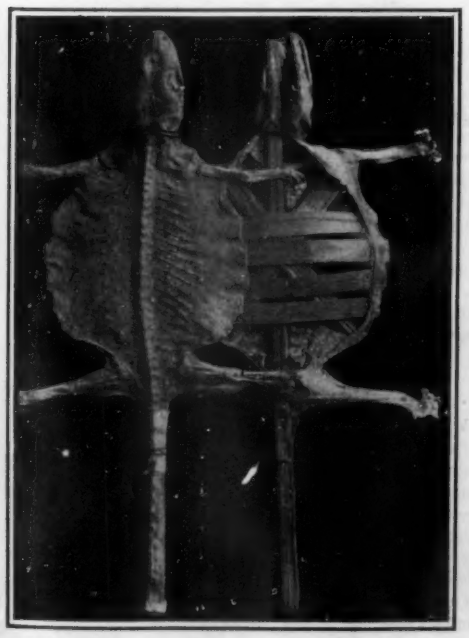
In old England the women were no doubt as anxious to appear charming as here in modern times, but their efforts to do so were far more simple and less expensive than now. For instance, if they were disfigured by warts, they merely had to steal a piece of beef from a butcher's shop, rub the warts with it, bury it, and (presto!) they disappeared; or, did their complexions need to be more pink, all they had to do was to eat some kind of plant, seeds and all; roses took the place of sallow skin. In Algeria, too, women follow this practice, using a plant called fenugreek for the purpose. The wonder of it all is how, after failure must have proved the inefficiency of the remedies in a large majority of cases, they went on believing (and in many countries still believe) in these absurd remedies; but had it not been so, human nature would have had to be different from what it is, has been, and probably will be, and there would then be no truth in the saying that every one likes to be fooled part of the time.

It would not do to omit mention of the powerful aid rendered by the various gods and goddesses in China, India, Java, Korea, and other countries, in exorcizing disease. The Hindoo goddess who had a superintending power over smallpox, for example, was approached with solemn ceremonies and presents to propitiate her. She was represented as standing with two uplifted fingers, threatening to strike on the right and left. Before her was a band of the executors of her vengeance, two of them with red grinning masks, black shields, and naked scimitars. White lines, like rays, issued from the bodies of the others, to indicate infection. On the right was a group of men with spotted bodies inflicted with the malady; bells were hung at their cinctures, and a few of them waved black feathers. These were preceded by musicians with drums, who supplicated the pity of the furious deity. From behind her advanced a bevy of smiling young women, gracefully carrying on their heads baskets with thanksgiving offerings, in gratitude for their lives and beauty having been spared. A little boy with a bell at his girdle conveyed something emblematic of inoculation from the arm of the goddess. By such means and humble intercession the benign goddess gradually stayed her fury, and the diseased were thus made whole, or were at least supposed to be cured, which appears to have answered just as well. In Java some idols are provided with bells for calling the attention of the god and goddess to the need of their exercising sacred powers in behalf of the sick and unfortunate.

Akin to this blind faith is the credulity of some classes of Japanese, whose doctors know very little more of anatomy and physiology than the patients themselves, and for purposes of diagnosis they rely mainly on the pulse. Three pulses are found to be in each wrist, they explain, viz., the heart, controlling the right upper pulse; the lungs, the left upper pulse; the stomach, the right middle pulse; the liver, the left middle pulse; the right kidney, the right lower pulse; and the left kidney, the left lower pulse. Thus, by a careful examination of the six pulses, he at once discovers what is the matter with the patient, and proceeds in his own way to effect a cure, or to instil into the patient's mind that he is already made whole. In Korea and among the North American Indians images are made out of various materials, each kind having peculiar power over some special form of disease. Thus, the Zuñi Indian makes a clay image to represent a mountain lion, and the spirit of that animal, which is the guardian of the Northwest and the master of the gods of the hunt, comes to dwell in that object, protecting the owner from injury by accident and helping him to success in the chase. A Korean sorcerer's image, stuffed and covered with buckskin, and often represented as riding on horseback, is used in like manner, and is believed by the natives to be all-powerful in averting calamity and death.

An interesting announcement of which we shall look for confirmation with interest, comes from the School of Medicine at Rochefort (France) regarding a new radio-active substance discovered by a young student named Luncien. It is said that the substance is uranyl-molybdate, and as its constituents uranium and molybdenum are fairly abundant elements there should be no undue trouble in providing the materials, nor would there be in preparing the substance. The molybdate is formed by adding ammonium molybdate to uranyl nitrate, when a white amorphous powder separates. This is dried in the dark and apparently must be kept there, as it is unstable. It is said to give radio-active effects practically as intense as those given by radium. Though costly—about $110 per ounce—the price is slight compared to radium, which has reached many thousands of dollars per ounce.

Commander Peary's attempt to reach the Pole has been postponed for twelve months. In a statement which he has issued, Mr. Peary says that the delay has been caused by the failure of the contractors who were installing new boilers to keep their agreement. The work was to be completed on June 1, but was two months late. The "Roosevelt" will, it is hoped, be able to visit Etah, Greenland, this year, where it will deposit a supply of coal for its use next year.



Dried Lizards Stretched on Splints of Bamboo. Used in China as a Medicine. Reptiles are Widely Used as Fetiches.

Straw Image (Korea) Thrown Out of the House on the Last Day of the Year to Carry Sins and Bad Luck with It.

Javanese Idol with Bell to Call the God.

Hawaiian Fetich of Human Thigh-Bone and Braided Human Hair. A Supposed Means of Warding Off Misfortune.

The unscientific mind usually attributes sickness or misfortune to some malign external influence which must be appeased. In the supplication or propitiation an object of human origin, or one modeled into human form, is frequently used.

MAGICAL CURES.

A HOME-MADE ALTERNATING-CURRENT RECTIFIER.

BY WILMAR P. LENT.

The experimenter who has only alternating current at his disposal is seriously handicapped by the lack of an apparatus which will successfully convert this alternating current into unidirectional or direct current. Likewise, the owner of a gasoline automobile, having alternating current at hand, greatly feels the necessity for a rectifying apparatus suitable for charging his ignition batteries. For large currents and high efficiencies, the mercury arc rectifier is pre-eminently satisfactory; but for small currents, when the efficiency is not so important and first cost becomes a serious item, the electrolytic rectifier answers. In what follows we will first summarize the principles and essential features involved in the successful action of the electrolytic rectifier, and then give plans for the construction of a small apparatus suitable for charging storage batteries, operating electrolytic processes, and in fact supplying current for any use requiring from 3 to 5 amperes at 15 to 25 volts.

An electrolytic rectifier consists essentially of an aluminium and a conducting plate (of carbon, lead, iron, or any metal not attackable by the electrolyte) immersed in an electrolyte which is capable of acting in a certain manner on the aluminium when current passes from an external source through the cell. It is found that when a current flows from the conducting plate to the aluminium (i. e., when the aluminium is made the cathode) there is no resistance encountered beyond that of the electrolyte; but when an attempt is made to pass the current in the other direction (making the aluminium the anode) so great a resistance is met with that the current practically will not flow. This peculiar action is attributed to a very thin coating of oxide which forms on the aluminium plate. The cell has been aptly called an "electric valve," in that it allows electricity to pass freely in one direction and not in the other. Cells possessing this property are called asymmetric.

The application of this cell to the rectification of alternating currents will readily be seen. One-half of the alternating wave can be suppressed by placing the rectifier in circuit. *A* (Fig. 1) represents the sine curve of an alternating current. When the cell is put in circuit, the curve assumes the form shown at *B*. It will be seen that only half of the current is used. It is possible, however, to so connect up one or a number of cells to utilize all the current, that is, to change the sine curve to a curve as shown at *C*. Figs. 2 and 3 represent two of the methods of connection.

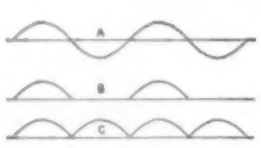


Fig. 1.

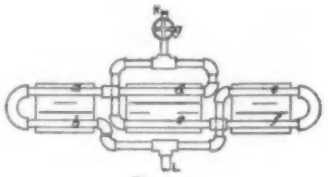


Fig. 5.

Fig. 6.

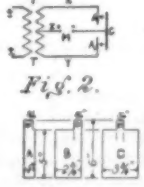


Fig. 2.

Fig. 3.

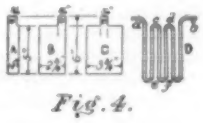


Fig. 4.

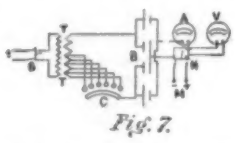


Fig. 7.

DETAILS AND CONNECTIONS OF THE ALTERNATING-CURRENT RECTIFIER.

In Fig. 2 ± represents the alternating mains, *T T* a transformer having three secondary terminals, *X Y Z*, of which one (*Z*) is attached to the middle of the secondary coil, and A, A_1, C, aluminium and carbon plates respectively in an asymmetric cell. Current passes in the direction of the arrows; it cannot pass in the opposite direction. No electricity can pass between *A* and A_1 in either direction in virtue of the oxide films on both of the plates. When *X* is negative, the current traverses the path $Z\,M\,C\,A\,X$; when *Y* is negative the path is $Z\,M\,C\,A_1\,Y$. The current at *M* is unidirectional. In Fig. 3 ± represents the alternating-current mains, $A\,A_1\,C$ an asymmetric cell as in Fig. 2, $C_1\,A_2$ and $C_2\,A_3$ two more cells. Current passes through the cells in the direction of the arrows. No current can flow from *A* to A_1 or from A_1 to *A*. When *X* is positive, the current follows the path $X\,C_1\,A_2\,M\,C\,A\,Y$; when *Y* is positive, the path is $Y\,C_1\,A_2\,M\,C\,A_1\,X$. The current at *M* is unidirectional.

Of these two methods of connection, the one shown in Fig. 2 is without doubt the best—the resistance of the electrolyte is much less, there are fewer sources of leakage, the apparatus is more compact, etc. The difficulty in its use lies in the fact that it is protected by patents. The method of connection shown in Fig. 3, devised by the author, will be used when the construction of the rectifier is taken up.

There are certain factors essential to the efficient operation of an electrolytic rectifier. First, the electrolyte to be suitable must have a low resistance, must not attack the aluminium when current is not passing through the cell, must not attack the aluminium too vigorously when current is passing through the cell, and must be composed of a stable substance. Sodium phosphate acidulated with sulphuric acid, potash alum, Rochelle salts, phosphoric acid, and in fact most of the soluble phosphates, sulphates, and tartrates, meet the requirements with more or less success. The author has had considerable satisfaction from the use of acidulated sodium phosphate solution.

The surface density at the aluminium plate must be comparatively high—not less than 1/10 of an ampere per square centimeter of surface. On account of this large amount of current traversing the electrolyte, the heating is quite excessive. Since the efficiency decreases greatly as the temperature rises, an adequate means of maintaining a low temperature must be provided. Cold water, passing through glass worms in the electrolyte, is the most efficient method.

It is inadvisable to apply more than a certain voltage to a single cell. Beyond this limit the oxide film seems to break down and lose its asymmetric properties. The limit voltage for an aluminium-sodium phosphate-carbon cell is about 30 volts. Higher voltages may be rectified by connecting cells in series.

CONSTRUCTION OF A SMALL RECTIFIER.

The following are plans for a rectifier suitable for utilizing 104 to 110 volt alternating current at commercial frequencies, and for delivering direct current of 3 to 5 amperes at 15 to 25 volts. The apparatus can, however, be made to utilize any alternating-current voltage by merely changing the transformer.

It is necessary to have a transformer to step down the voltage of the alternating-current line to a value which may be handled by a single cell. Since more than 15 or 20 volts direct current is rarely needed for electrolytic work, this transformer has the further advantage of increasing the secondary current without increasing the main-line current. Thus less current is used from the supply mains for the same direct current than if full potential were employed. For want of space here, the designing of this transformer, being quite simple, is left to the builder, who, if he is not sufficiently well informed, may consult any standard textbook on alternating currents. The transformer must be constructed to deliver 5 amperes and 25 volts at the normal load. Leads must be brought out from a few of the end coils for voltage regulation. (See Fig. 6, *C*.)

The rectifying cells have hard-rubber or glass containing jars, the middle cell with the two aluminium plates being 6 x 4 x 2½ inches, and the end cells with one aluminium plate 6 x 3 x 2½ inches inside measurements. The aluminium plates are cut out of ⅛-inch sheet aluminium, and are the same size and shape for all the cells. (See Fig. 4, *A*.) The carbon plates are cut from ¼-inch carbon plate with an old hacksaw. (See Fig. 4, *B* and *C*.) Two of *B* are made for the end cells, and one of *C* for the middle cell. Both the carbon and aluminium plates are provided with binding posts as shown in the figure. The lugs of the carbon plates are dipped in melted paraffin to prevent creeping of salts. Hard-rubber tops are provided for the jars to retard evaporation of the electrolyte. The carbon and aluminium plates are suspended from this top, and held ½ inch apart by hard-rubber separators. The positions of the plates in each cell are shown in Fig. 5.

Six glass worms (Fig. 4, *D*) are bent from ⅜-inch (outside measurement) glass tubing with thin walls. They are of a size to fit correctly on each side of the plates in each cell (*a b c d e f*, Fig. 5). The inlets and outlets (*a* and *b*, Fig. 4, *D*) should rest on the edges of the jars, *c* and *d* should just project above the surface of the electrolyte, and *e* and *f* should nearly reach the bottoms of the jars. Fig. 5 shows the connections of the water-cooling system, *a b c d e f* representing the glass cooling worms. They are connected with each other and the water supply and waste (*K* and *L* respectively) by stout rubber tubing bound on tightly with wire. The water is supplied by ⅛-inch iron piping; the waste is ¼-inch pipe. As the middle cell passes twice as much current as the end cells (refer to Fig. 3) it will get twice as hot. With this condition in mind, the cold water is first passed through the middle cell and then through the end cells. The end cells may be kept cool enough by increasing the water supply at the valve *g* (Fig. 5).

If the electrolyte is of acidulated sodium phosphate, a saturated solution of the phosphate is prepared and the jars filled, with plates and cooling worms in position, to within an inch and a half of the top. After the apparatus is assembled, the sulphuric acid is added as will be shown below.

The switches are shown in the assembled apparatus (Fig. 6). *G* and *H* are ordinary 15-ampere knife switches on slate or porcelain bases. *F* shows a conventional fuse block on the alternating-current line. Three ampere fuses are quite sufficient. *C* is a point switch controlling the voltage of the transformer. Small binding posts *b b* are provided for convenient connection with the electrolytic cells; they are insulated from the panel by hard-rubber bushings and washers. At *M* are two massive binding posts; the direct current is taken off here. *A* and *V* are an ammeter and voltmeter respectively. These instruments may be omitted, though they are very useful. They must be of the hot-wire type to correctly record the pulsating current. *T* represents the transformer; *g* is the handle to the valve controlling the cooling water; *K* and *L* represent the inlet and outlet water pipes respectively; the alternating mains are shown at ±. *W W W W* represent the connections of the cooling worms. The panel is of ½-inch seasoned oak, 16 x 29 inches. At *B* is a shelf of the same material.

The electrical connections are shown diagrammatically in Fig. 7. ± represents the alternating current mains controlled by the switch *G*, *T T* is a transformer, and *C* the switch controlling the voltage of its output. *B* shows the asymmetric cells connected as in Fig. 3. *A* is the ammeter connected in series with the direct-current circuit; *V* is the voltmeter connected in shunt across same. *H* is the direct-current switch, and at *M* are the binding posts where the direct current is obtained. All the wiring is done behind the panel on porcelain insulators. The piping for the water cooling is also partly behind the board.

When the panel is all connected up, the electrolyte is brought to the proper conductivity by adding sulphuric acid in each cell until the ammeter registers 5 amperes at full load. Before using the rectifier in actual work, the aluminium plates must be "formed." This is accomplished by running the rectifier with a resistance at *M* (Fig. 6) at full load for a couple of hours. In starting the apparatus, first turn on the main alternating-current switch *G* (Fig. 6); then regulate the voltage by the switch *C* to the desired value. Close the direct-current switch *H*. The current is now regulated to the proper quantity by *C*. Now turn on the water by the valve *g*, but slightly at first, then more and more as the cells grow hotter. The best efficiency is obtained when the cells are coldest and the current density is greatest. To stop the apparatus, open the direct-current switch *H*, then the alternating-current switch *G*, and lastly turn off the water. The aluminium plates will need occasional cleaning, as a hard barnacle-like substance forms on them. At certain intervals the aluminium plates will need renewing because they wear away slowly. The electrolyte will also have to be changed each time the plates are renewed.

The current obtained from such a rectifier as described above is not strictly direct-current but pulsating, unidirectional current. (See Fig. 1, *C*.) This type of current is desirable for charging storage batteries, as more time is allowed for chemical action, and therefore less "gassing" is the result. Let it be understood, however, that the wave form of the current does not hinder its application to the operation of all direct-current machinery.

Fighting Coal Mine Fires With Chemicals.

For fighting fire in its anthracite coal mines a new form of chemical fire engine is now being used by the Delaware, Lackawanna & Western Railroad. This engine is built on a truck which can run upon tracks throughout the mine. When an alarm of fire is sounded the engine is attached to an electric mine locomotive and rushed to the scene of trouble at high speed. Water played upon a coal fire is almost instantly converted into steam, which further disintegrates, forming a gas so suffocating that it drives away the men fighting the fire. Blue flames which shoot out when water strikes the hot coal often set ablaze pockets of gas in the ceiling. When a chemical engine plays upon burning coal the heavy gases evolved cling to the floor and smother the blaze by excluding the air. Men are not annoyed by the fumes and can stay close enough to do effective work.—Railway Engineering Review.

THE MEATS WE EAT.

The recent rise in the cost of meat, which has affected the pocketbook very severely, has awakened considerable interest in the subject of meat slaughtering and meat packing. This is one of the most important industries in the country, and the total value of the products is well up toward the billion mark. The following table prepared by the Bureau of the Census gives the salient facts concerning this gigantic industry:

SLAUGHTERING AND MEAT PACKING—MATERIALS USED, BY KIND, QUANTITY, AND COST; AND PRODUCTS, BY KIND, QUANTITY, AND VALUE: 1905.

Materials used, total cost	$805,856,969
Beeves:	
Number	7,147,835
Gross weight on hoof, pounds	7,485,407,944
Net weight, dressed	4,066,264,877
Cost	$289,040,930
Sheep:	
Number	10,875,339
Gross weight on hoof, pounds	930,168,367
Net weight, dressed	464,872,621
Cost	$44,359,804
Hogs:	
Number	30,977,639
Gross weight on hoof, pounds	6,586,349,782
Net weight, dressed	5,048,832,850
Cost	$329,765,480
Calves:	
Number	1,568,130
Gross weight on hoof, pounds	261,683,572
Net weight, dressed	161,049,581
Cost	$12,665,557
Dressed meat, purchased fresh or partially cured (to be manufactured)	$53,114,957
All other materials	$76,848,336
Products, total value	$913,914,624
Beef:	
Sold fresh—	
Pounds	3,748,055,377
Value	$247,096,724
Canned—	
Pounds	98,663,931
Value	$7,697,815
Salted or cured—	
Pounds	136,896,697
Value	$8,107,952
Mutton, sold fresh:	
Pounds	460,754,244
Value	$36,880,455
Veal, sold fresh:	
Pounds	154,212,652
Value	$12,856,369
Pork:	
Sold fresh—	
Pounds	1,224,932,910
Value	$91,749,323
Salted—	
Pounds	1,558,886,256
Value	$116,626,710
Hams, smoked bacon, sides, and shoulders:	
Pounds	1,364,015,706
Value	$132,210,611
Sausage, fresh or cured:	
Pounds	324,416,039
Value	$25,056,331
All other meat, sold fresh:	
Pounds	124,307,081
Value	$9,579,718
Lard:	
Refined—	
Pounds	1,048,362,039
Value	$74,116,991
Neutral—	
Pounds	120,724,361
Value	$8,423,973
Oleomargarine oil:	
Gallons	19,454,799
Value	$10,201,911
Other oils:	
Gallons	4,893,133
Value	$2,595,951
Fertilizers:	
Tons	211,137
Value	$4,397,626
Hides:	
Number	8,039,204
Pounds	456,443,857
Value	$44,206,107
Wool:	
Pounds	16,377,333
Value	$5,229,521
All other products, including amount received for custom and contract work	$76,880,536

The figures are for the year 1905 (the last totals available) and we have attempted to show graphically, as we have already done with bread, etc., what this industry really means.

The composite beef, which is literally on the hoof, is only 1,236 feet long to the shoulder, and is only 927 feet high to the shoulder. This animal only weighs some 7,485,407,944 pounds as he stands on his hoofs, but cuts up with some loss of weight, the product being:

	Pounds.
Fresh beef	3,748,055,377
Canned	98,663,931
Salted or cured	136,896,697
	3,983,616,005

Showing an apparent loss of 3,501,791,939 pounds, but all that comes to the meat packer is in the nature of grist, and it is doubtful if the actual loss is very great. The hides, the horns, the hoofs, the bones, the blood, etc., all have to be reckoned with.

The fresh beef is represented by hind and fore quarters of beef, one 480 feet high, the other 504 feet, and 280 and 290 wide respectively. The beef that is salted would fill a barrel 220 feet high and 147 feet in diameter at its widest point. Canned beef makes a nice little seven and a half million dollar can, 145 feet high and 128 feet wide. That much-abused animal, the pig, also makes a good subject, for the total number of hogs slaughtered in 1905 was 30,977,639, weighing 6,586,349,782 pounds on the hoof, and 5,048,832,850 pounds, dressed, thus showing a comparatively smaller shrinkage. The cost was $329,765,480, and value of the product was much more. The height of the composite hog would be 785 feet, and the length "over all" would be 1,570 feet. The pork that is salted would fill a barrel 332 feet in diameter at its largest part, and 495 feet high. The lard would fill a tin pail 334 feet high and 295 feet in diameter. The smoked ham would be 499 feet high and 374 feet across at its widest part. The sausages placed end to end would make a continuous chain 151,714 miles long, or 6.1 times the circumference of the earth.

The sheep is the smallest of the trio, being only 666 feet long and 555 feet high to the shoulder. This animal is made up of 10,875,339 sheep, and weighs 930,168,367 pounds on the hoof, but the net weight is 464,872,621 pounds, showing quite a shrinkage. The amount of fresh mutton sold amounted to 460,754,244 pounds, valued at $36,880,458.

The total value of the material used was $805,856,969, and the total value of the products was $913,914,624, showing a difference of $108,057,659, certainly a tidy little sum for labor and profit. Such is in brief the slaughtering and meat packing industry.

Correspondence.

The Capsized Lighthouse Caisson.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 15, 1906, I notice an article relating to the lighthouse in Chesapeake Bay which tipped over during construction some two years ago. As I made a personal examination of this lighthouse at the time, and also made plans for its restoration, I thought it might be of some interest to your readers to know these conditions, as the field is a broad one, and the same principle might apply to the salvage of vessels to a limited extent.

In carrying out the plans for building the lighthouse, a wooden caisson was constructed on shore in Baltimore, and then launched and towed to the site of the proposed lighthouse, after having placed the first ring of cast-iron segments on the deck. When it was towed to the site, this cast-iron shell stuck up above the water, as the line of flotation was somewhere near the top of the caisson. As soon as the caisson reached the site, additional rings were put on and then some concrete was placed in the shell, causing the caisson to settle down in the mud. Owing to the fact that there was a little more concrete on one side than on the other, the caisson settled unevenly, one side being about 2 feet lower than the other. The cast-iron shell at this time was 25 feet high, and divided by two bulkheads into three sections of equal width but unequal areas. The two outside sections were to be filled with concrete, and the center section with stone and sand. The section on the low side had about 120 tons of concrete in it, and the other side considerably less.

It was at this point that it was decided to level up the caisson by putting on an excess of concrete on the high side, and it was this excess load on one side which tipped the structure over. Concrete was placed in the section on the high side until the caisson began to settle on that side, and the more it settled the greater the overturning effect of the excess load, which was about 150 tons, became. The movement continued until the structure lay on its side, almost in a horizontal position. The slight storm which occurred at this time had no effect whatsoever. The material at the point where the caisson landed is very soft mud for a depth of 30 or 40 feet. As a matter of fact, the mud is so soft that it is very difficult to determine with a sounding lead just where the mud actually begins. This being the case, the caisson was landed in a material which was almost as fluid as the water, and it was almost as difficult to maintain the equilibrium of the structure as if it had been entirely afloat. The mud was so soft that when the structure tipped over, it sank in the mud for a distance of 20 feet. This, coupled with the fact that the wood, which was light and tended to float, was on the bottom of the structure, and the cast iron and concrete, which were heavy, were on top, makes it apparent that this structure was most unstable at best; and as the construction progressed the instability increased, so that it would seem practically impossible to have constructed this lighthouse without a very strong pile structure around it to hold it straight, when as a matter of fact there was nothing whatsoever to fasten to except the barges, which were simply anchored.

There can be no question but that the uneven loading led to the wrecking of this structure, and it seems incomprehensible that any contractor would undertake a construction of this kind without a thoroughly substantial pile structure to support the work, and it is also surprising that the government engineers would permit the work to proceed without such a structure.

With regard to the problem of righting the structure, there was only one of two things to do, but there were several ways of doing the work along either one of these lines. First, the cast-iron segments and concrete could be removed, and it would be a simple matter to handle the caisson, which was of wood. The other method was to straighten the structure up as a whole. With regard to removing the concrete and cast iron, it might be blown off with dynamite, but the objection to this was the destruction of the cast-iron segments and the probable damage to the wood in the caisson. The five shafts which ran through the concrete into the caisson also added to the difficulty of using this method. An attempt was finally made, I believe, to remove the cast-iron segments by the use of divers; this attempt was apparently a failure, and it left as the only feasible method the straightening up of the structure as a whole.

This involved the handling of something over a thousand tons of weight in addition to whatever mud may have gotten into the structure, owing to the fact that it was 20 feet deep in the mud, this weight being somewhat reduced by the displacement of the submerged parts; but it meant that a structure must be rigged for lifting at least a thousand tons, in order to be sure that there would be sufficient power to do the work. One of the problems involved in this method was the question as to whether the timber structure of the caisson, which was simply fastened with drift bolts, would not pull apart just below the deck when sufficient strain was put on it to lift the structure. The weight which it was necessary to lift was too much for any floating derrick, and a permanent pile structure was necessary, with rigging of a very substantial nature, arranged in such a way as to completely right the structure. This important point seems to have been overlooked in the rig described in your paper, as it seems that it only raised the structure to an angle of 45 deg. and could not get it any further. The method proposed at the time involved the construction of the two pile platforms as described in the article in your paper, but instead of using the derrick as shown, it was proposed to build this pile structure to a height sufficient to allow the caisson to swing clear in revolving upward. On top of the pile platforms it was proposed to erect a heavy timber cribbing, and on top of this cribbing to place steel plate girders spanning the space over the caisson. These girders were to be made so that they could take the load at any point. On top of the girders it was proposed to place eight 200-ton hydraulic jacks with a stroke of 2 feet. Over the top of these jacks would be passed a 2-inch plow steel wire cable, which would be passed around the cast-iron shell so as to make one full turn, with the ropes crossing each other on the bottom of the caisson, and returning back over the top of the jacks, the ropes being fastened together where they crossed on the bottom. The ropes would be cut into short pieces with sockets fastened on the end of each piece, and the pieces fastened together through the sockets, so that the short pieces could be removed as the caisson was lifted. There being eight jacks altogether, it was calculated that four jacks would be enough to hold the caisson in position while the other four were being changed. It was also proposed to use two girders, in order to enable the shifting of the position of the girders if necessary as the caisson rose. It would also be necessary to shift the position of the jacks toward the center of the girder as the caisson rose. This was all provided for, and while this is practically the same principle as was actually used in straightening up the structure, it was designed for considerably heavier work than that which was used, and was intended to completely right the structure.

21 Park Row, New York. ERNEST C. MOORE.

THE "TYPHONOID"—A NEW TYPE OF MOTOR BOAT.

BY M. J. PELTIER.

The racing motor boat herewith illustrated was launched on July 27, 1907, at the Bellvaire shipyard, near Nantes, France. The boat is the invention of M. André Gambin. Its principal dimensions are: Length over all, 59 feet; length on water line, 52½ feet; greatest width over all, 5¼ feet; greatest width at water line, 4 feet 7 inches; molded depth, 4 feet 4½ inches; mean draft, 2 feet 7½ inches; area of amidship section, 7.14 square feet.

When afloat the boat presents a very trim appearance, with no suggestion of the very peculiar apparatus by which it is propelled. M. Chauvalon, the assistant constructor of the little vessel, claims that it cannot be capsized, except possibly in making a short turn at high speed, when great skill on the part of the steersman will be required.

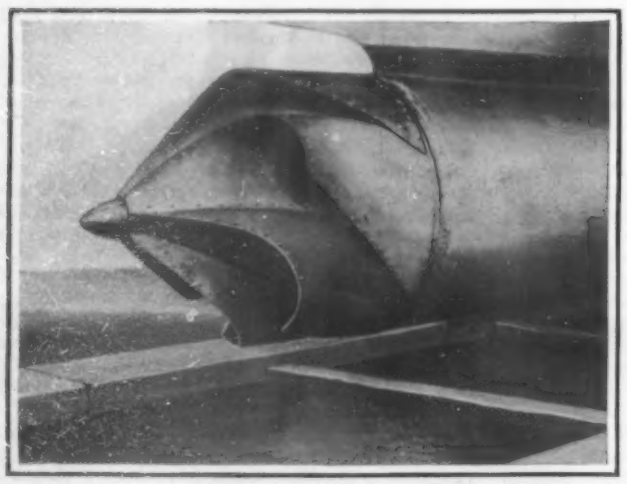
The motive power consists of two 4-cylinder V-type motors of 60 horse-power each, coupled together and to the propeller shaft. Double ignition, by magneto and by accumulators, is provided, to lessen the chance of failure. The boat is propelled by a "typhonoid" screw, 31½ inches in diameter, which is placed at the bow, as shown in the illustrations. The inventor has guaranteed a speed of 100 kilometers, or more than 62 miles, per hour.

M. Gambin, after fifteen years of fruitless attempts to improve the action of the ordinary screw propeller, conceived the idea of converting the defects of that apparatus into advantages by the adoption of the "typhonoid," placed at the bow, instead of at the stern of the vessel. Without going into theoretical details it may suffice to point out that the injurious effects of centrifugal displacement and the central void are thus converted into beneficial effects and the limit to the advantageous increase in the velocity of rotation of the propeller is removed. The name *typhonoid* is derived from a Greek word which means a whirlwind, and the apparatus is designed to act by suction, in the manner of a waterspout.

Very curious experiments were made by the inventor two years ago with models about 8 feet long, driven by clockwork, and velocities exceeding 40 miles per hour were obtained. Last May another series of experiments was made with a typhonoid 2 inches in diameter, for the purpose of determining the tractive effort and the energy expended in moving large and measured volumes and weights. The results were not only satisfactory, but surprising. From these two series of experiments it seems fair to infer that the typhonoid will produce the maximum speed for a given expenditure of power. Furthermore, as the typhonoid presents no projecting edges, it is manifestly superior to the ordinary screw propeller for the navigation of shallow waters containing vegetable growths. The typhonoid propeller consists of a number of blades—six in this instance—symmetrically distributed around an axis and terminating in a cylindrical tube. Each blade is composed of two sheets or surfaces. One sheet is spiral-cylindrical, like a loosely-rolled sheet of paper, with its inner edge at the axis and its outer portion forming part of the enveloping tube. The other sheet is smaller, inclined and helicoidal, like the blade of an ordinary screw-propeller. It extends from the front edge of the cylindrical sheet to a spiral line traced some distance behind the front of the cylindrical sheet of the preceding blade. The front edges of the two sheets of each blade are riveted together and form a salient cutting edge which slopes backward from the apex to the circumference at an angle of 45 deg to the axis.

A French naval engineer, after making a minute examination of the inventor's plans and calculations, has asserted that the Gambin typhonoid far surpasses all other propellers in efficiency and has expressed his confidence in the ability of the new boat to develop a speed of much more than 62 miles an hour, with an expenditure of energy of 100 horse-power.

NOVEL MOTOR BOAT FITTED WITH A NEW FORM OF PROPELLER KNOWN AS A "TYPHONOID."



SIDE VIEW OF THE NEW PROPELLER, SHOWING ITS LOCATION AT FORWARD END OF TUBE.

Cement Telegraph Poles.

BY C. M. GINTHER.

Telephone, telegraph, and electric railway managers and investors will be interested in a new concrete pole, invented by Mr. William M. Bailey, of Richmond, Ind.

In a general way the poles are built on the plan of all armored concrete work, though the construction is quite distinctive in character. In the body of the pole and near its circumference, equally spaced, are continuous rods of twisted electro-carbon steel especially prepared for this purpose. These rods are tied together and held in position by continuous spiral binding wires. These form the skeleton work of the pole, or the reinforcement, which is then inclosed in a form into which cement is poured. After a number of days the form is removed, and the result is a concrete pole.

Extreme climatic conditions of summer and winter or heavy demands upon the strength and elasticity of a heavy pole line leave the poles made by this process absolutely unimpaired. One of the features of the poles is their remarkable elasticity. A 30-foot pole will deflect 31 inches at the top without cracking the concrete. The breaking strain of the pole is figured at 5,000 pounds—three times the strength of the common wooden pole.

Carefully calculated accounts of all expenditures for labor and material in the construction show that under average conditions the first cost is slightly more than that of cedar poles. While the average life of a cedar pole is about twelve years, that of a concrete pole is practically unlimited. When a cedar pole decays, the labor cost of removing it and attaching the wires to a new pole is far greater than the cost of the pole itself. Such cost is by far the greatest item of depreciation in both telephone and telegraph properties. Indeed, this very item is perhaps the only one that has made telephone securities less desirable than railroad stocks. With cement poles this renewal cost is eliminated.

A further important saving in depreciation is the protection these poles afford against lightning. Each pole becomes a lightning rod, being lightning-proof itself, thus protecting wires, instruments, and electrical machinery.

Another risk to be considered from the investors' standpoint is the destruction of pole lines in sleet and wind storms. The ruin thus wrought is often a fearful loss. But no storm of wind or sleet, or both combined, is likely to affect a line of cement poles, so great is their strength.

The poles are graceful in form and outline, fresh and new in appearance, never need painting, and can be aligned to mathematical exactness. In point of appearance and safety there is another factor in their favor, they being constructed in such a way as to make the pole self-supporting, thus taking care of all strains without the necessity of dangerous and unsightly anchorage.

Our forests are disappearing rapidly, and good cedar poles are almost unobtainable, and the price of those of even moderate quality is fast advancing.

It is estimated that there are forty million poles in the ground in the United States, worth two hundred million dollars. These poles have an average life of twelve years. More than 3,200,000 poles are required every year to replace those decayed, at a cost of from fifteen million to seventeen million dollars per annum. When it is considered that much of this may be saved by the use of concrete poles, their enormous value to the public service corporations of the country may be appreciated.

A table of road resistances in pounds per ton (of 2,240 pounds), has recently been published in England. The figure given railroads is 10. Asphalt has second place with 15, 22 and 29 pounds for good, medium, and poor, respectively. Tramways and wood paving are each placed at 30. The best macadam is from 43 to 46; ordinary quality from 50 to 60; and soft macadam as high as 97 pounds per ton. The best gravel and cobbles are given as 57 and 60 respectively, while ordinary and very bad cobbles are placed at 130 and 240 pounds. Dry, hard clay is said to offer a resistance of 100 pounds per ton; a sand road, 360 pounds; and loose sand, no less than 560 pounds, or 25 per cent of the weight to be moved over it.—Iron Age.

THE "TYPHONOID" VIEWED FROM THE FRONT.

MAGNIFIED MODELS OF INSECT PESTS.

BY DAY ALLEN WILLEY.

One of the most unique and interesting industries in this country is the reproduction of minute forms of life by means of models of such size that the anatomical features of each creature can be observed and studied by the naked eye without the aid even of the common magnifying glass. This industry has been so perfected that each part of the insect or other form of life reproduced is so faithfully copied that it is absolutely true to nature.

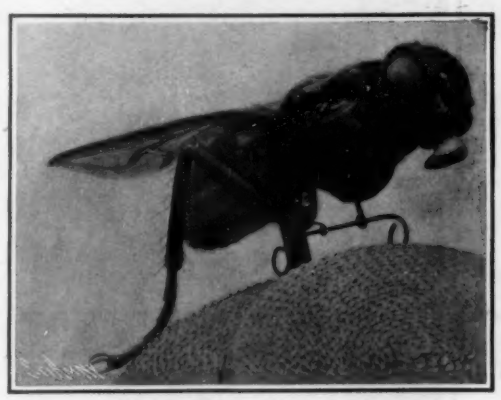
In recent years the discoveries in science have indicated clearly the damage done, especially to farm crops, by various types of insect pests, but besides these there is a number of insects, either harmful or annoying to human beings, of which we have been furnished much valuable information. The importance of having likenesses of these for the purpose of study is obvious, and this is one reason for the construction of the models to which we have referred. The maker of these mammoth representatives of insect life is a woman, who has devoted herself to entomology, and thus has become familiar with the subject. For a period of years Mrs. Otto Heidemann has made collections in various parts of the country, in association with her husband, who is one of the entomologists connected with the Department of Agriculture at Washington. From continued study of her specimens Mrs. Heidemann became expert in insect anatomy, and familiar not only with the general appearance of the body, but also with the shape and object of portions so small as to be invisible except under a powerful microscope.

To reproduce a leg, a wing, an eye, or some other part on a scale which may be several hundred times as large as the original, and reproduce it accurately in shape, is no small achievement, and furthermore, it may possibly have to be colored to resemble the insect's natural hue. Then it must be composed of material which will retain the shape into which it has been fashioned by the modeler. When we think of even the mosquito or house fly, with the position of their legs, the curves of their wings, the conformation of their heads, it is evident that the worker must have a variety of materials in order to make a successful reproduction. Mrs. Heidemann has not only utilized wire, thread, celluloid, *papier maché*, and rubber, but has been obliged to devise compounds of various substances to suit her needs. The nature of these compositions is known only to herself.

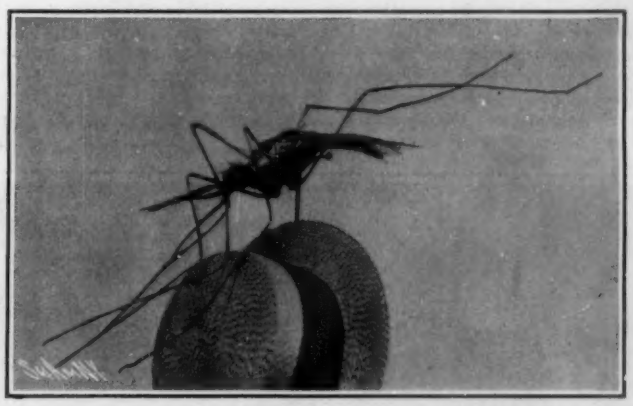
In fashioning an insect model, the skeleton of the body is of course one of the most essential features. In many cases this can be made of steel wire, which not only retains the proper shape, but is also strong enough for the purpose, and has the necessary lightness. The covering of the skeleton depends on the nature of the insect. Some have the surface of the body covered with microscopic hairs. Others have smooth bodies. *Papier maché* is suitable for many of the models, but occasionally something else must be substituted such as celluloid. Usually, wire forms the "bones" of the leg, but if it must be made thicker in some portions than others, Mrs. Heidemann coats it with one of her compounds. She proportions the leg properly while the material is plastic; when it hardens it assumes a permanent form. The wings of most of the designs requiring them are composed of celluloid of the proper thickness. Occasionally wire may be needed around the edge or beneath to strengthen the wing, but as a rule the material is sufficiently stiff and strong to be used without any reinforcement. Even the minute hair is imitated with fine silk threads, while Mrs. Heidemann has also suc-

Gigantic Model of the Destructive Cotton Boll Weevil.

The Full-Grown San Jose Scale and Its Larva (at the Left).

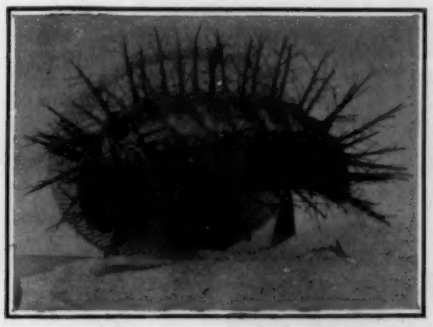


The Common House Fly is Fortunately Smaller Than This Model.

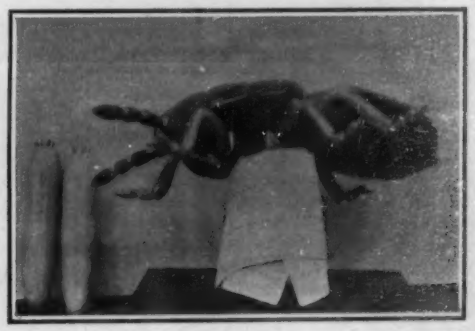


Reproduction of the Anopheles Mosquito; a Good Example of the Naturalness of the Work.

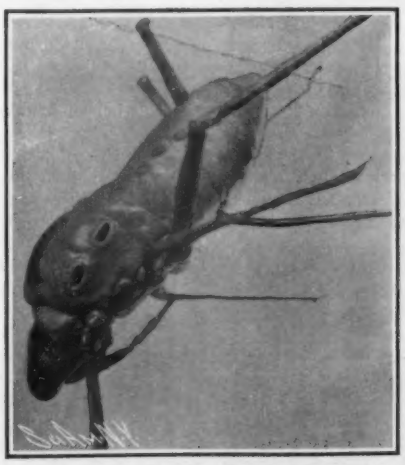
A Model of Honey Bees Filling the Cells of a Comb.



The Repulsive Larva of the Lady Bug.



The Chinch Bug and Two of Its Eggs.



The Plant Louse. The Models Are Nearly as Large as a Page of the Scientific American.

Huge Model of an Apple, Showing a Worm and the Ravages It Has Committed.

MAGNIFIED MODELS OF INSECT PESTS.

ceeded in devising a substitute for the covering on moths, which so strongly resembles feathers when seen under the microscope.

In making one of these giants of the insect world, the body, the wings, or the legs may be made first according to convenience, but before beginning operations Mrs. Heidemann executes a working drawing. This is indispensable in order to attain the proportions. In short, the creature is literally mapped out on paper before any part of it is finished. The drawing is always done with the aid of the microscope. After the specimen to be modeled is placed under the lens, the instrument is properly adjusted. Mrs. Heidemann next singles out a portion, and carefully scanning it as it appears enlarged, traces it on the paper. Then selecting another portion, she repeats the process until she has traced what might be termed an anatomical outline. The paper on which the drawing is made is carefully measured and divided into squares of equal size. In this way the exact proportions of the enlargement are more easily obtained.

With the drawing before her eyes, it is necessary only to select the part to be made first and begin the work. The tools of the modeler are few and simple. Pincers, scissors of various sizes, needles, and several knives comprise most of the outfit, but though the equipment is not elaborate, the various processes require so much time that a model may be several weeks in finishing. Mrs. Heidemann does not work continuously on a single specimen, however, but may have several under way in her curious laboratory, finishing a part of one, then of another, as may be most convenient to her. The occupation also produces such a nervous strain, that she is obliged to desist frequently and rest from it. The Division of Entomology of the Department of Agriculture contains a very interesting collection of these gigantic facsimiles of minute animal life. The collection has been arranged under the supervision of Dr. L. O. Howard, Chief of the Bureau, and is not only interesting but highly instructive as well, especially to all interested in agriculture. It includes the cotton boll weevil, which has inflicted such damage to the staple crop of the South and which the Bureau of Entomology is vigorously striving to eradicate. As seen thus magnified, the weevil slightly resembles an enormous spider with a long snout. This snout is the most closely studied of all parts of the weevil, and with good reason, for the creature uses it in boring into the boll, thus destroying or damaging the contents.

By means of the models the distinction between the various species of mosquitoes can be clearly traced with the eye unaided. The specimens in Dr. Howard's collection include the variety supposed to carry the germs of fever, the comparatively harmless singing mosquito, and the kind which is believed to spread malaria. It would be difficult for even an expert to detect the difference in the actual insect unaided by the microscope, but as already stated, the models make the distinction plain. As a matter of fact, the more harmless of the series might be considered the most dangerous, for it is much uglier in appearance than the others, with its spotted legs and scraggy body. The anopheles, which has such an evil reputation for its bite, is the most harmless in appearance. An idea of the many times which the insects have been magnified can be gained when it is stated that the smallest mosquito is more than twice the length of an ordinary straw hat measured from the ends of its fore legs to the ends of the hind ones. The chinch bug, almost invisible in life, is reproduced in the collection much larger than a pair of cuffs, while its eggs, microscopic in their natural proportions, are as large as shotgun cartridges.

One of the curious results of this magnified modeling is the repulsiveness and ugliness of some of the insects least dangerous to us, and the attractiveness of some of the most harmful ones. Perhaps the most common winged creature which we know is the house fly. It is found everywhere—on the table, sometimes in the food—and it has a most annoying habit of alighting on the person and sometimes preventing sleep. We are so accustomed to it, that we brush it away without further thought. Nervous people might shudder were they to see the specimen in Dr. Howard's collection, for it is one of the ugliest of all. Its legs end in sharp claws that might easily tear one's flesh if the fly were of this size, while the head with its great eyes and what seems to be a protruding jaw adds to its savage appearance. In decided contrast to it is the codling moth, really a beautiful creature with its many-tinted coat of "feathers." This, however, is the bane of the fruit grower, for from it comes the worm that bores into the heart of the apple, and often destroys most of the fruit before it works its way to the surface. One of the most interesting parts of the collection is a huge apple made principally of *papier maché*, showing the worm done in plaster, feeding in its interior. The homeliest specimen in the collection is one of the greatest friends of the horticulturist. This is the variety of beetle known as the lady bug or lady bird. It is probably the greatest enemy to the San José scale which has thus far been discovered. It is needless to refer to the great damage done to peach orchards in various parts of the country until the lady bug was introduced and fed upon the pest. As seen magnified, the beetle looks like a land turtle with its thick rounded shell. It is large enough to hold a cigar in its mouth, which gives a further idea of the enormous size of the reproduction. On the other hand, the body of the scale is quite graceful in form and its wings resemble lace, so delicate are they in appearance, but the long legs and huge eyes of the creature cause it to bear a slight resemblance to a lobster. The ugliest specimen of all, however, is a design of the larva of the lady bug, which looks like a worm from whose skin project sharp spines resembling miniature tree trunks. This was one of the most difficult models to complete, while the plant louse has so few legs and feelers that it is one of the easiest specimens to reproduce. Yet as is well known this living mite is one of the greatest foes of the farmer, since it gets into the green kernels of wheat and other grain, and kills them by absorbing the moisture. It is estimated that the louse has destroyed $10,000,000 worth of cereals in a single season.

While these models have undoubtedly been of great value in giving agriculturists and others, who have visited Washington and seen them, an idea of insect structure and habits, all have had an opportunity to become familiar with the best methods for eradicating those which are pests. But such is the interest manifested in insect study, that there is a constant demand for the models from the managers of State fairs and other rural displays, and they are frequently sent out for the purpose of exhibition. The idea of utilizing illustrations of the models, prepared on the same scale, for instruction, is also finding favor among the agricultural colleges, and there is no doubt that already they have been of much benefit in educating the rural classes in a very important topic to the farmer.

Fig. 3.—APPLICATION OF HIGH-FREQUENCY CURRENTS IN THE FORM OF ELECTRIC SPRAY IN CASES OF EXCESSIVE ARTERIAL PRESSURE.

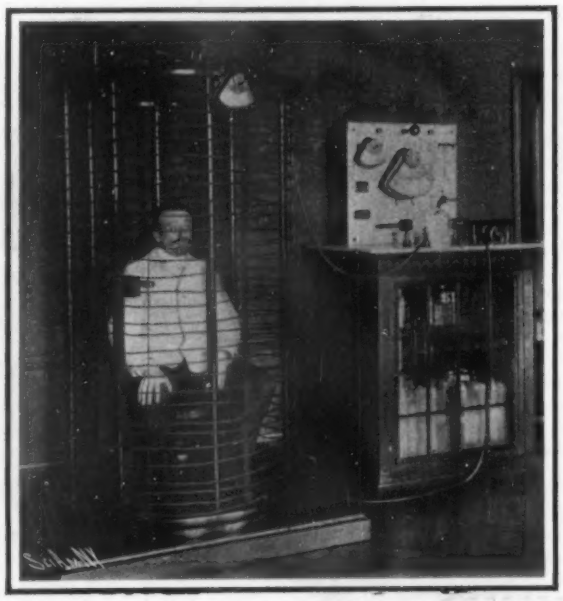


Fig. 1.—DR. MOUTIER'S APPARATUS FOR THE REDUCTION OF ARTERIAL PRESSURE BY MEANS OF HIGH-FREQUENCY CURRENTS.

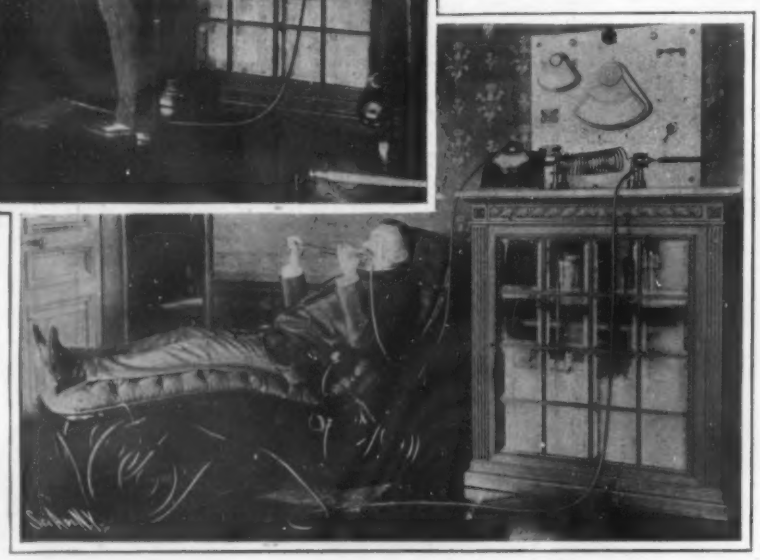


Fig. 2.—CONDENSER BED.

EMPLOYMENT OF HIGH-FREQUENCY CURRENTS IN THERAPEUTICS.

BY JACQUES BOYER.

The arterial blood pressure, which is equivalent to about 6 inches of mercury in health, rises to 10 inches or more in certain diseases and falls to 4 or 5 inches in other diseases—neurasthenia, for example. Excessive arterial pressure is a common symptom of arteriosclerosis, or hardening of the arteries. It is easily detected by the sphygmometer, but until very recently no method of arresting the progress of the disease was known.

Now, however, arteriosclerosis appears to be curable by the method of Dr. Moutier, which is based upon Prof. d'Arsonval's discovery that the blood pressure is instantly reduced by the action of high-frequency currents.

The patient is seated on a chair inside of a spiral coil of wire which is traversed by high-frequency currents. (Fig. 1.) The cabinet shown at the right of the photograph contains a transformer, which gives to the alternating current a tension of 40,000 or 50,000 volts and a frequency of 500,000 or 600,000 alternations per second. This treatment, continued for five minutes, reduced the arterial pressure from 10 to 7 inches. In a second treatment, given to the same patient a few days later, the arterial pressure, which had risen during the interval to 8 inches, was brought down below 7 inches in a few minutes. Repeated applications gradually reduce the arterial pressure to its normal value of 6 inches. In Dr. Moutier's very interesting experiments, the rapidity with which the pressure was lowered appeared to have no relation to the age or gravity of the case, or the degree of hypertension, but to depend chiefly on the state of digestion.

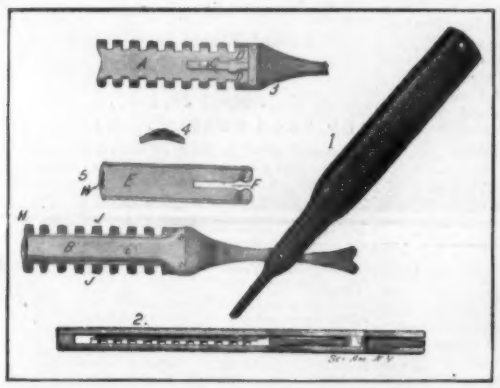
The duration of treatment consequently varies with the condition of the patient, but in general only a few treatments are required. The important feature is that the cure—the reduction of arterial pressure to the normal value—is permanent, and that the progress of the arteriosclerosis is arrested by the removal of the excess of blood pressure. Dr. Moutier has even witnessed the disappearance of functional troubles caused by this hardening of the arterial walls.

By the use of the condenser bed (Fig. 2) Dr. Moutier has succeeded in ameliorating the condition of gouty and rheumatic patients by means of high-frequency currents conveyed directly to the body by the conductor, which is grasped by the hands of the patient.

Finally, the arterial pressure, if abnormally low, can be increased by the action of high-frequency currents applied in the form of the electric spray or effluvium. The patient, seated on an insulating platform (Fig. 3), grasps one electrode, and the other, which is a comb with a number of points, is moved up and down along her spine but at some distance from it. In this way Dr. Moutier has successfully treated a number of cases of neurasthenia.

AN IMPROVEMENT IN SAFETY RAZORS.

In the accompanying engraving we illustrate a razor of the "safety" type which has the form of an ordinary razor and which, furthermore, is provided with removable, double-edged blades. The blades are secured in what may be called the body portion of the razor, and this body portion is formed with a tang which is pivoted in a slotted handle, so that the razor may be folded after the usual manner to protect the cutting edges. The body portion of the razor comprises a guard section, *A*, and a cover plate, *B*, fastened by screws to the guard section. The latter is shown in Fig. 3 with the cover plate removed. Formed

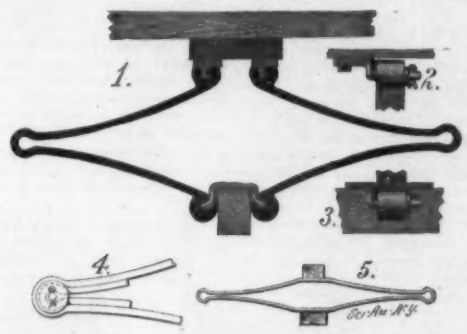


AN IMPROVEMENT IN SAFETY RAZORS.

on the face of section *A* is a tongue or rib, *C*, provided with a pair of opposite lateral projections, *D*. When the cover plate is fastened in place the tongue, *C*, serves to space it from the guard section. In the narrow space or slot so formed the thin razor blade, *E*, is received, as shown in cross section in Fig. 4. The razor blade (see Fig. 5) is slotted at *F* and is formed with notches, *G*, so that when the blade is pressed home between the members *A* and *B*, the slotted ends will spring over the projections, *D*, and interlock therewith. The outer end of the razor blade extends beyond the guard and cover and is formed with finger holds, *H*, whereby it may be grasped and withdrawn from the body portion whenever desired. The razor is formed with opposite cutting edges, which are safeguarded in the usual manner, by means of projections, *J*, on opposite edges of the guard section, *A*. Each razor is equipped with a magazine of blades, so that when a blade becomes dull it may be removed and a fresh blade immediately inserted. A patent on this improved safety razor has just been secured by Mr. J. F. Bailey, Owens Ferry, Ga.

A NOVEL VEHICLE SPRING.

A patent has recently been secured on a new form of spring which, while elastic under a light load, is equally efficient under a heavy load, owing to its self-reinforcing characteristics. When the spring is forced down into the bolster one member will support the other, so that the spring will not have a tendency to break. As shown in the accompanying illustration, the spring consists of two sections of identical form. The sections are made of bar steel, bent to form an upper and a lower member, connected at their outer ends by an open loop. The inner ends of these members are provided with eyes, whereby they may be applied to the vehicle. Both the upper and lower members are curved inwardly, this curvature being on the arc of a 70-inch circle. The method of attaching the sections to the sill of the vehicle is illustrated in Fig. 2. A bracket secured to the sill is provided with a projecting end, which passes through the eye of the upper member, and is made fast by means of a cotter pin. The lower members are secured to the bolster by means of a pair of U-shaped clips, which saddle the bolster. One of the clips is provided with extensions, which pass through the eyes of the spring sections, and the eyes formed on the other clip end are secured by means of cotter pins. This provides a simple means of applying the spring sections to the vehicle. Owing to the curvature of the spring sections, when a heavy weight is carried by the vehicle the upper and lower members of the spring will be forced into contact with each other, and there-

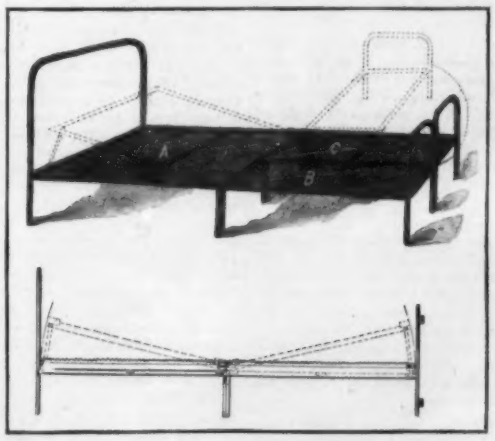


A NOVEL VEHICLE SPRING.

by tend to reinforce each other. A modification of this spring is shown in Fig. 5. It will be observed that the spring consists of a single continuous band of metal in place of two separate sections. A means for strengthening the spring is shown in Fig. 4. It consists of an inner auxiliary spring section, having a terminal eye with two leaves extending therefrom. This auxiliary spring is inserted in the loops of the main spring, and secured therein between a pair of washers by means of a bolt and cotter pin. In practice the leaves of the auxiliary spring serve to support the main spring at its weakest point. The inventor of this novel vehicle spring is Mr. Herman A. Grafe, of Newburg, Oregon.

AN IMPROVED INVALID'S BED.

A number of important improvements are embodied in the invalid's bed which we illustrate herewith. The bed is made in sections, which may be separated and adjusted relatively to each other, so as to enable the physician or nurse to gain convenient access to the patient without materially discommoding the latter. The sections are so arranged that one or both lower limbs or the trunk of the patient may be elevated, as desired. In the illustration the main section is indicated at *A*, and the two foot sections at *B* and *C*. Each section consists of a frame supporting an individual bed-spring section. As shown in one of the figures, each bed-spring section at its outer end is provided with arms pivotally attached thereto, so that when the spring section is raised, the arms thereon will rest on the slats of the bedstead and hold the spring section in place. The arms may be formed with notches adapted to engage the slats, and whereby the sections may be adjusted to any desired angle. The foot sections of the bed are secured to the main



IMPROVED INVALID'S BED.

section by means of hinges, so that they may be swung laterally apart, if desired. The sections are locked together by means of a U-shaped bolt, which passes through eyes formed at their adjacent outer ends. When the bed is thus locked together, it may be used as an ordinary bed. It will be observed that the construction is very simple, and that the bed is adapted for home use, as well as for use in a hospital. A patent on this improved bed has been granted to Mr. Charles O. Lewis, of Fayette, Mo.

BARREL STAND AND TRUCK.

Pictured in the accompanying engraving is an improved barrel stand and truck, intended to facilitate the handling of barrels while inserting a faucet therein, and to assist in placing the barrel in position and in removing the same from place to place. When lifting the barrel to an upright position after the faucet has been applied, there will be no danger of injuring or breaking off the faucet. The stand also provides means for collecting the drippings from the barrel and storing them in a reservoir. One of our illustrations shows a cross section of the stand, showing its box-shaped form. The stand is supported on four truck wheels. The rear end of the stand is curved to provide a rocking surface, on which the stand may be rocked or tipped downward to the position shown by dotted lines in one of the illustrations. At the rear of the stand are a pair of adjustable handle bars, comprising a pair of side bars and an upper cross bar. The side bars are preferably tubular, and are adapted to receive the downwardly-turned ends of the cross bar. A pair of set screws threaded into the side bars are adapted to engage the ends of the cross bar, and firmly secure the latter at the desired adjustment. The upper face of the stand is provided with an octagonal depression formed by nailing molding to the stand. The depression is covered with zinc plate. In this depression the barrel is seated, and any drippings therefrom will collect and flow through an aperture therein into a reservoir below. This reservoir is a vessel supported on a shelf in the stand, and may be readily removed when desired to empty its contents. In use the stand is tipped over to the position shown by dotted lines, and the barrel is then rolled on to the handles. When in this position the faucet is applied, and then the barrel and stand may be lifted to upright position.

BARREL STAND AND TRUCK.

A patent on this barrel stand and truck has been secured by Mr. Peter T. Herreid, of Blair, Wis.

The Source of Radium.

Doubts have been cast on the generally accepted theory that radium is a decomposition product of uranium, says Nature. A recent investigator showed that, starting with a solution of uranium nitrate carefully purified by repeated crystallization, the amount of radium formed in eighteen months was less than 1-2,000 of the amount which the disintegration theory called for. In a recent experiment upon the growth of radium from actinium, this same scientist decomposed a kilogramme (2.2046 pounds) of carnotite ore, containing about 20 per cent of uranium, in an excess of hydrochloric acid. This solution was then so treated as to separate the actinium from the other constituents. It was secured in the form of a chloride, which was then sealed in a glass tube. After two months the gases from the tubes were placed in an electroscope and the activity of the emanation determined. The tube was then resealed and allowed to remain for several months longer. The emanation at the end of this time was found to indicate an activity corresponding to three times the former amount of radium. From this rate of increase it is computed that the half period for the evolution of the emanation would be about 3,100 years. Since the amount of actinium in a mineral is apparently always proportional to the amounts of uranium and radium present, it is thought that actinium may prove to be the looked-for intermediate product.

First American Turbine Liner.

America's first large turbine steamship, the "Creole," was placed in commission July 9. She was built at the Fore River yards, Quincy, Mass., and is one of the three vessels of the same size and type recently added to the Southern Pacific's Atlantic fleet, except that the "Creole" is propelled by turbines. The "Creole" is 440 feet long, 57 feet beam, displaces 10,600 tons, and has a speed of 18.5 miles per hour carrying 4,500 tons. In addition to the cargo, she has 152 staterooms and accommodations for 250 steerage passengers.

RECENTLY PATENTED INVENTIONS.

Hardware.

LOCK.—A. N. WICKHAM, Lincoln, Neb. This lock may be placed in a door with a portion of the casing bearing the latch-bolt arm arranged uppermost. It may be inverted and placed in the door with that portion of the casing bearing latch tumblers and locking tumbler arranged uppermost. So arranged these tumblers drag over the inner casing and fall into locking engagement with the casing of their own weight, and operate even if certain springs become inoperative. Means aid in holding the tumbler edges against the inner casing, as the end of the latch bolt extends through the face-plate of the main casing.

SNAP-HOOK.—F. S. BIEBER, Poughkeepsie, N. Y. This hook may be termed a rein and trace hook, since it is particularly designed for use on the portions of the harness of horses that draw fire engines or fire apparatus or other heavy vehicles. The purpose of the inventor is to provide a snap hook that will quickly receive a ring or link, and from which the ring or link can be quickly and conveniently removed.

Heating and Lighting.

COMBINATION BOILER AND FURNACE.—N. FROST, Bloomington, Ill. This invention relates to heating apparatus having a boiler arranged within a furnace and both located within a warm air chamber, thus utilizing the generated heat for hot air heating and ventilating purposes as well as for direct or indirect steam heating purposes. The object is to utilize the heat generated by the burning fluid to the fullest advantage.

HEATING ATTACHMENT FOR GRATES.—F. A. DELPH, New Orleans, La. This attachment is for use with open grates, and consists of one or more return flues or pipes detachably connected with a front plate adapted to cover the space above the grate basket and projecting therefrom into the room where the grate is located. The plate is hinged to the grate frame so that it may be swung laterally together with the return pipe or flues, when desired to replenish the grate basket.

Household Utilities.

SAD-IRON HEATER.—N. A. WESTERLUND, Superior, Wis. The object of the improvement is to provide an arrangement whereby a number of sad-irons may be heated and moved conveniently from place to place. More specifically, the invention contemplates an arrangement whereby the same handle may be used for moving the heater or for applying the irons to the ironing board.

MOP-HEAD.—ESTHER M. LEFEVRE, New Paltz, N. Y. This mop head provides an effective means for scrubbing floors and cleaning walls, especially cornices, moldings, and ledges of all kinds, where there are numerous crevices and cornices which are difficult to reach by mop heads hitherto devised. It will be found to be of advantage in scrubbing stairways, where it is necessary to mop about railings and in the corners impossible to be reached by the ordinary mop head.

Machines and Mechanical Devices.

KINEMATOGRAPHIC APPARATUS.—R. T. HAINES, Melbourne, Victoria, Australia. The invention relates to mechanism designed to produce a more perfect reproduction of living pictures or animated scenes upon any desired exhibiting surface by obviating the fluctuation of light, flickering and blurring and by minimizing the vibration and unsteadiness, spots and other imperfections or irregularities, which render so unsatisfactory all processes and mechanisms now in use.

NUMBERING APPARATUS.—O. G. BARTUSCH, New York, N. Y. The object here is to provide an apparatus, more especially designed for use in printing presses to consecutively number the printed sheets, and arranged to permit the use of a prefix forming part of the actuating mechanism for the numbering wheels and interchangeable with a non-prefix part automatically covered up during the passage of the inking rollers to prevent inking of the non-prefix part without cutting the rollers or requiring the use of a frisket.

LIFTER ATTACHMENT FOR TYPE-SETTING AND TYPE-CASTING MACHINES.—E. C. LAMPSON, Jefferson, Ohio. It is sought by this invention to enable an operator to raise the assembler at will as many times and as often as he cares to do so, the ascent of the assembler being always made with uniform speed and both the ascent and return of the assembler being positive, yet the movement requiring principally no expenditure of energy, the entire handling of the assembler being effected by the application of power.

LOOSE-LEAF BINDER.—J. F. GLOR, Manning, Iowa. The improvement relates to that form of binder in which two symmetrical halves are made to clamp the edges of the loose leaves and have telescopic anchorage posts which protrude through slots in the leaves and also marginal clamping edges which by suitable mechanism may be adjusted toward or from each other to clamp or release the interposed leaves.

Railways and Their Accessories.

CAR-FENDER AND TRACK-CLEANER.—J. DONOS, New York, N. Y. The provision made in this invention is for a fender and cleaner for use on street cars, automobiles, and other vehicles, and arranged to allow convenient and quick adjustment of the fender relative to the roadway or track rails, and to permit the person in charge of the vehicle to quickly throw the fender or cleaner into an active position or to move the fender into an inactive position.

LOCOMOTIVE-PILOT.—B. T. HAMILTON, Fort Smith, Ark. Switching engines are provided on their forward ends with a draw beam having a coupling adapted to be connected with a car in front of the engine. Such are generally used without a pilot or with a stub pilot so as not to interfere with coupling the engine to a car on its forward end. No pilot used, the engine is not suited for road service, as live stock when struck by the engine going at high speed are liable to be thrown under the train and cause serious accident. When a stub pilot is used the draw beam projects so far beyond the face of the pilot that the stock when struck often become lodged under the beam and fall off the pilot to the track, frequently derailing the train. This invention provides a pilot for use on an engine designed for switching or road service. Mr. Hamilton has invented another pilot, which is adapted to remove obstacles and live stock from the path of the train when used for road service, and to be adjusted relatively to the draw beam so as not to interfere with coupling of the cars to the forward end of the engine when switching.

Of General Interest.

MUSIC-HOLDER.—J. B. WAY and C. FEZLER, Patchogue, N. Y. One embodiment of this invention consists of an open frame-work having means for holding the back sheets in open position. A number of spring-pressed arms, each having a device for removably attaching it to an intermediate sheet of music, are held against the tension of the springs before the sheets are turned by the stem of the key, the latter being operable to successively release the arms and detached sheets.

LEVELING-ROD.—F. WULFF, Torreon, Coahuila, Mexico. This rod easily takes the reading on a horizontal line, through a level, to the small fractional part of a dimension and accomplishes this directly without referring to the unit marks on the rod below or above the reading and without undue straining of the eyes. The rod is covered with graduations on all sides, which provide sufficient space for marking the figures in large type, the graduations of each succeeding side differing by a fraction of a unit, which gives the graduations a spiral trend thereabout.

CHIMNEY-COWL.—E. A. GERRARD, Monroe, Neb. In this improvement the action of the wind on the uppermost blades operates to draw up smoke and the like from a revolving tube and thus increases or improves the draft and clearance at the top of the chimney as desired. The cover is formed from a flat plate of metal approximately square and bent to bring its diagonally opposite corners downward to form the side wings. The wheel is mounted to turn loosely on its shaft, the latter being bushed to operate without unnecessary noise. The vane is preferably made of sheet metal.

SEPARATING-POT.—G. NEBEL, Monterey, Nuevo Leon, Mexico. This separating pot is for use in smelting, to separate the matte from the slag, as well as from the crust formed by the cooling of the slag. The inventor remedies many defects by providing a pot without holes, and having a special shape by virtue of which the slag and matte as well as the crust are poured or taken out separately, and so rapidly that only a very thin crust is formed on the sides of the pot.

ELLIPSOGRAPH.—J. T. KELLEY, West Rush, N. Y. The invention relates to improvements in ellipsographs and more particularly to means whereby curves other than arcs of circles may be readily drawn. It is particularly designed for drawing ellipses, and the compass may be set to draw an ellipse of any given major or minor axis as readily as an ordinary compass can be set for drawing a circle of a given diameter.

PROSPECTING-TOOL.—T. JOHNSTONE, Muskegon, Mich. The tool is such as used by miners in locating ore deposits. It is especially useful for gold miners in locating gold deposits in ancient river beds or streams. The inventor's object is to produce a tool readily operated to raise a quantity of the deposited earth, and which will afford means for quickly separating the solid portions of the earth from the water which is brought up with the earth.

DENTIMETER.—R. H. MACY, West Palmbeach, Fla. One purpose of the invention is to provide an instrument especially adapted for releasing and holding the ends of a wire when measuring a tooth or a root in crown bridge work. Another is to provide an instrument of but two members, and to so construct and combine said members that the ends of a loop of wire may be quickly and conveniently inserted into the instrument and locked thereto, and as speedily released therefrom.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

RUSTIC CARPENTRY. Edited by Paul N. Hasluck. With numerous engravings and diagrams. Philadelphia: David McKay. 16mo.; cloth; 160 pages. Price, 50 cents.

"Rustic Carpentry" is a form of amusement that can readily be indulged in by all, whatever their mechanical skill may be. This little work contains directions for making a number of useful and ornamental objects in rustic style.

ELECTRICAL IGNITION FOR MOTOR VEHICLES. By W. Hibbert. New York: The Macmillan Company. 16mo.; cloth; 128 pages. Price, 50 cents.

The ignition of gasoline engines has become a subject of such general importance that every one connected with their operation must have some knowledge of electricity. This book deals with all phases of the subject, including batteries, both primary and storage, and magnetos. The appendix contains the principles upon which battery action is founded, as well as the fundamental laws of electricity.

MOTOR BICYCLE BUILDING. Edited by Paul N. Hasluck. With numerous engravings and diagrams. Philadelphia: David McKay. 16mo.; cloth; 160 pages. Price, 50 cents.

Although motor cycles may seem at first sight to be very complex pieces of mechanism, yet when resolved into their component parts they are reasonably simple. There is no reason why anyone of ordinary mechanical ability should not build for himself a motor cycle, if he has at his disposal the proper directions and the correct designs. This handbook contains, in comprehensible form, a number of articles contributed by a cycle and motor maker and expert, Mr. W. Travers, to "Work," a weekly journal. It is complete in all its details and contains a chapter on Ignition Coils by Mr. G. E. Bonney, the well-known writer on practical electrical subjects.

A HANDY BOOK FOR BREWERS. Being a Practical Guide to the Art of Brewing and Malting. Embracing the Conclusions of Modern Research Which Bear Upon the Practice of Brewing. By H. E. Wright. Third edition, thoroughly revised and enlarged. London: Crosby Lockwood & Son. New York: D. Van Nostrand Company. 8vo.; cloth; 562 pages. Price, $5.

Brewing is an art in which the final product is affected by a multitude of conditions, many of which have but recently been discovered, while others are so obscure that their very existence can only be guessed at. The truly successful brewer should have combined in himself, besides a knowledge of the raw materials he makes use of, the qualities that go to make up the chemist and the biologist. Naturally, a textbook on such a subject must cover a field so wide that to merely give a hint of its contents would be nearly impossible. One can form a slight idea of its efficiency from the fact that, besides the description of raw materials and their preparation, the headings, "Water for Brewing," "The Laboratory," "Ferments," "Culture from a Single Cell," and "The Brewery and Plant," are included in this excellent work, as well as a number of other chapters of almost equal importance.

THE HUMANIZING OF THE BRUTE. Or the Essential Difference Between the Human and Animal Soul Proved from Their Specific Activities. By H. Muckerman, S.J. St. Louis: B. Herder. 12mo.; cloth; 114 pages, 5 plates. Price, 75 cents.

If the thought-processes of the human mind are difficult to trace, how much harder must it be to follow the impulses that produce the activity of the lower forms of life. The most common method of investigating these impulses is very apt to be untrustworthy; namely, the observation of various actions, and the supplying, from our own experience, of the mental attitude that prompted them; since the observer projects himself into his interpretation. The author has avoided this error in his work, which consists of a collection of observations discussed with a view to proving that man owes his reasoning powers to the possession of a "soul"; a something which he alone has. To us it seems, though, that the treatise proves the lower forms of life to possess brains of correspondingly low development and memories correspondingly short, reducing the results of experience to a negligible quantity, rather than that there is a sharp dividing line between mankind and the rest of the creation.

PROBLEMS OF THE PANAMA CANAL. Including Climatology of the Isthmus, Physics and Hydraulics of the River Chagres, Cut at the Continental Divide, and Discussion of Plans for the Waterway. With History from 1890 to Date. By Brigadier-General Henry L. Abbott, U.S.A. Retired. New York: The Macmillan Company. 8vo.; cloth; 269 pages. Price, $2.

Although our nation is engaged in the completion of one of the greatest engineering projects that has ever been attempted, there is little literature on the subject that tells of the work in a complete and readable manner. "The Panama Canal" is a name that has been frequently dinned in our ears of late, yet few of us know, even in a general way, the enormous difficulties that are there being surmounted. Brigadier-General Henry S. Abbot, who was for seven years connected with the work in question, has written of the problems of the canal in a manner that deserves the highest commendation. His book is a minute and painstaking description of every detail of the great labor, with full tables of statistics in every department of the work, yet so remarkably is the subject matter composed that the interest to the casual reader is not destroyed. The engineer in search of exact information, and the layman wishing for general information will both find it equally interesting.

THE BARTON FIRST AID TEXT BOOK. A Manual for the Student in First Aid. By H. H. Hartung, M.D. Arranged and Illustrated by Roscoe G. Wells. Second edition, revised and enlarged. Boston: The National First Aid Association of America. 12mo.; cloth; 134 pages. Price, $1.

The subject of "First Aid to the Injured" should be placed in such forms as to be readily reached by all. One can never tell when his knowledge of rough-and-ready surgery may save a life. "The Barton First Aid Text Book" begins with a short description of the anatomy of the human body; it then deals with the circulation and respiration. The rest of the book is taken up with valuable information on bandaging, treatment of patients for poisoning, what to do in case of shock, and how to transport the wounded or injured.

ANNALS OF THE ASTRONOMICAL OBSERVATORY OF HARVARD COLLEGE. Vol. LV. Part I. Second Catalogue of Variable Stars. By Annie J. Cannon. Under the direction of Edward C. Pickering. Cambridge, Mass.: Published by the Observatory.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending August 13, 1907, AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Adhesive applying mechanism, A. Shedlock	863,106
Adhesive supplying mechanism, O. Tyberg	863,119
Adjustable bracket, J. T. & G. W. Huff	863,068
Advertising device, W. Hornich, Jr	863,278
Advertising vehicle, W. A. Harrison	862,904
Air brakes, quick action automatic release mechanism for, L. Krimmelbein, reissue	12,680
Air compressor, motor driven, Priest & Bring	863,556
Air drill, portable, S. P. Johnson	863,030
Albuminous substances, treatment of, R. Dengeorge	863,268
Alimentary products, manufacture of, P. Mueller, Jr.	863,081
Aluminium, solder for, C. Ellis	863,058
Ammonia, etc., obtaining, H. Koppers	862,976
Amusement apparatus, J. W. Armitage	863,133
Amusement device, F. V. Crosbier	863,262
Animals, device for the prevention of the practice of onanism in, W. Leech	863,291
Anthraquinone compound and making same, Isler & Kacer	863,397
Antiskidding device, E. B. Stimpson	863,331
Anvil, clamping, F. W. Covert	863,511
Automobile vehicles, construction of, M. Birkigt	863,348
Axle, G. G. Smith	863,328
Bag holder, O. P. McGregor	863,039
Baling presses, pumping mechanism for, S. C. Beale	863,138
Ball molding apparatus, golf and other playing, P. Dick	863,366
Balls, making playing, F. H. Richards	863,448
Bark mill, E. F. Smith	863,459
Basin, catch, S. G. Howe	863,181
Bearing box, C. D. Parker	863,087
Bearings, safety brass for motor, C. T. Powell	863,089
Bed, sofa, R. Deimel	863,365
Bench and tack receptacle, combined, W. J. Porell	863,219
Beverages, manufacture of, L. Nathan	863,085
Bicycle attachment, H. J. Phillips	862,936
Bicycle support, G. S. Tiffany	862,945
Bin. See Packing bin.	
Binder, H. V. Wagoner	863,242
Blind, window, J. McCord	863,573
Blocking machine, F. L. Atherton	863,344
Board dropping device, W. Pines	863,439
Bobbin molding apparatus, fiber, W. H. Thompson	863,472
Boiler flue blower, T. E. Hutchins	863,538
Boilers, machine for fastening crown stays in, H. E. Lewis	863,074
Bolt clipper, H. W. Smohi	863,111
Book, pocket memorandum, A. Mieden	863,036
Bookcase, sectional, J. L. Kershaw	863,286
Boot hook, J. Moore	862,986
Bottle, antirefilling, J. B. Vaughn	863,476
Bottle filling machine, W. J. Cunningham	863,363
Bowling ball, S. G. Wilson	863,126
Box closure, J. P. Nikonow	863,327
Brake, N. J. Clute	863,359
Brake beam, N. H. Davis	863,157, 863,158
Brake head, adjustable, N. H. Davis	863,267
Braking apparatus, W. Lockett	863,193
Braking construction, E. B. McKenna	863,420
Bread, making, D. Childlow	862,962, 863,021
Breeching, attachment for hip or Yankee, T. F. Long	863,194
Brick cleaning machine, old, A. Le Blanc	863,190
Brush, W. S. Walker	863,243
Brush, G. S. Butterfield	863,260
Brush holder, W. L. Waters	862,951
Buckle, W. J. Fleming	862,892
Buckle, A. S. Huntington	863,280
Buckle, cross line, J. H. Haughawout	862,907
Buckle, cross line, T. Bean	862,950
Building block, J. H. Denmead	862,887
Building block, H. L. Pegram	863,435
Building block, R., G. & A. Arnsen	863,493
Building block, tile faced, W. P. Mecker	862,925
Button, P. P. Pfleghar	863,438
Button, separable, J. W. Lomax	863,543
Buttons, making pearl, N. Barry, Jr	863,498
Calamine, process to utilize the inferior, F. S. Moyano	863,417
Camera lenses, adjustable standard for, F. V. Conley	862,883
Can, E. Norton	863,086
Can closure, E. A. Hawkinson	862,908
Can or box opener, R. S. Hiltner	863,393
Cane cutter, E. M. Hibbler	863,534
Car door, grain, D. S. Bailey	863,494
Car fender, L. Ostermeyer	863,209

Car fender and guard, L. M. Maxham..... 863,198
Car friction draft rigging, railway, J. F. O'Connor 862,991
Car friction spring draft rigging, railway, Hennessey & Moore 862,910
Car motor, mine, J. B. Merwin 863,077
Car, motor tipped slag, J. C. Buckbee 863,259
Car mover, G. Spire, et al 863,112
Car side door, R. B. Kendig 863,285
Cars and other road vehicles, resilient wheel for motor, Oldfield & Schofield 863,206
Cars, flange and ice cutter for railway, J. H. Hampson 863,170
Carbureter, F. J. Cox 863,154
Carbureter, W. E. Downing 863,516
Card holder, S. P. Crouse 863,265
Carpenter's clamp, J. P. Fraker 863,373
Carpet stretcher, G. O. Bock 863,049
Carpet stretcher and tacker, G. Schilling.. 863,099
Carrier. See Pneumatic despatch tube carrier.
Carrier frame, folding, C. J. McIntosh 863,082
Cartridge shell, blasting, J. T. Brewer 862,878
Caster, F. L. Georgi 863,530
Cement applying device, C. E. Norris 863,429
Cement, method of and apparatus for applying and using, A. Thoma 862,944
Chain link, G. J. Meyer 863,079
Cheese cutter, C. M. Wright 863,340
Churn, J. Supper 863,099
Churn and butter worker, combined, G. J. Kaplan 863,282, 863,283
Cider, treating, L. Beyea 862,900
Cigar fillers, forming, W. S. Luckett 862,983
Cigar lighter, T. B. Murray 863,419
Cigar tip cutter, J. Weinbrecht 863,123
Cigar trimming and molding machine, Bright & Davis 863,503
Cigarette machine, S. I. Prescott 863,217
Cigarette machines, filler shaping mechanism for, S. I. Prescott 863,000
Circuit control apparatus, R. Fleming 863,165
Circuit controller, slow speed, H. A. Wallace 863,335
Cistern screen and filter, S. M. Renn 863,002
Cisterns, etc., mold for making, C. J. Uible 863,047
Clock, electric self-winding, A. Wirsching.. 863,339
Clock, geographical, P. G. Connor 862,884
Clutch, friction, H. J. Hase, et al 863,064
Coal tipple, J. S. Pates 863,313, 863,314
Cock, stop and waste, J. P. Farley 863,522
Coil terminal connection, field, E. W. Olds. 863,207
Coin holder, C. S. Marsh 862,984
Coke extracting machine, E. H. Abraham. 863,484
Coke puller, J. W. Hurd 863,537
Collar fastener, W. B. Dutemple 863,161
Collecting device, A. Shedlock 863,104
Coloring matter lake, C. Immerheiser 863,396
Combs, drawing-off mechanism for circle, Long & Foster 862,980
Concrete tubular structures, method and apparatus for forming reinforced, R. H. Aiken 863,485
Condenser, R. D. Tomlinson 863,115
Condenser plant, R. D. Tomlinson 863,116
Control device, safety, A. M. Mattice 863,197
Conveying apparatus, tripper or deliverer for, L. Moss 863,202
Cooking utensil, M. Haberman 862,903
Copy holder, H. D. Penny 862,993
Copying and manifold device, E. M. Wolf.. 863,480
Corking machine attachment, A. F. Biehler 863,501
Corn popping apparatus, C. Cretors 862,994
Corn shock tying device, A. Larson 863,289
Corn tester, seed, C. E. Twamley 863,474
Corner bead holder, J. Prescott 863,440
Corrugated pipe, helically, Isaacs & Speed. 862,919
Corset busk, N. Damon 863,156
Cotton cleaning feeder, J. R. Fordyce 862,893
Cracker cutting machines, pan skipping device for, A. Bielle 863,349
Crankshaft, sectional, A. F. Rockwell 862,998
Cultivating implement, hand garden, M. L. Carraway 863,020
Cultivator and fertilizer, J. E. Courtright. 863,024
Cultivator, cotton, J. E. Deer 863,513
Current motor, W. G. Baker 862,873
Currycomb and brush, combination, H. Howard 862,918
Currycomb and brush, combined, G. G. Seymour 863,457
Curtain fastener, G. Bishop 863,254
Curtain fixture, P. A. Houghtaling 863,395
Curtain fixture, G. H. Forsyth 863,525
Curtain fixture, W. Mansfield 863,547
Curtain pole, A. J. Cannon 863,357
Curtain stretcher, F. S. Stanfield 863,329
Curtain stretcher frame, E. B. Boush 863,223
Cuspidor, W. F. Ray 863,445
Cutter. See Cane cutter.
Cutting and ripping device, Carkin & Jefts 863,506
Cutting gage for lathes and other tools, W. Runge 863,097
Cutting machine, L. W. Sheldon, et al 863,227
Cycle stand, C. E. Singleton 863,327
Dental appliance, C. S. Case 862,881
Dental engine, W. W. Williamson 863,478
Dental engine handpiece, J. B. Springle 863,066
Display cane, Weaver 863,121
Ditch digging machine, G. M. & C. N. Schnell 863,319
Dolls, apparatus for turning and bowing the heads of, H. Fiedeler 863,270
Door check and closer, G. W. Mallory 863,413
Door, gable, L. Z. Bradbury 862,961
Door securer and corkscrew, combined, G. Prindle 863,091
Doubling and lapping machine attachment, Riley & Hamilton 862,997
Draft equaliser, J. O. Peterson 863,436
Draft rigging, tandem spring, J. F. O'Connor 862,932
Drawing board, W. C. McKenzie 863,307
Drill press, W. J. Bayrer 863,137
Drills, apparatus for sighting, W. M. Parker 863,574
Drilling apparatus, rotary, J. A. Wiggs, Jr. 862,954
Drum closure, steam, F. Seebeck 863,001
Dumping device, J. Gilmer 863,026
Dye and making same, anthracene, F. Kacer 863,401
Dye, black mordant azo, A. L. Laska 863,290
Dye houses or bleacheries, means for ventilating, J. H. Lorimer 862,981
Dyeing machine, Smith & Drum 863,469
Dynamo construction, H. Leitner 863,410
Egg case, H. S. Wood 863,481
Electric circuit protective device, T. I. Jeffries 863,185
Electric machines, means for protecting dynamo, C. P. Mosher 863,201
Electric meter, G. A. Sawin 863,224
Electric motors, automatic tripping safety device for, Herath & Hultman 863,177
Electric resistance device, H. W. Leonard.. 863,293
Electric time alarm, J. L. Grass, et al 863,570
Electrical energy, method of and apparatus for transmitting, W. C. Yeatman 863,247
Electromagnet, D. L. Lindquist 863,296
Electromagnetic sounding apparatus, Seidel & Sassenhoff 863,322
Embossing press, A. H. Uhrig 862,947
End gate, wagon, G. M. Parsons 863,432
End gate, wagon, B. L. Wilson 863,479
Engine sparking device, explosive, J. S. Elverson 863,369
Engine starter, automatic, W. J. J. O'Dea. 863,554
Engine starting device, J. Zilligen 863,249
Engine tender, traction, E. Mahr 863,546
Envelop opener, moistener and sealing device, combined, R. A. Orr 863,312
Explosive engine, Boudreaux & Verdet 863,142
Eyeglass mount, A. W. Antholne 863,343
Fabrics, tool for turning in the ends of tubular, C. F. Pinkham 863,215
Fan supporting base, electric, W. F. Phelps 863,214
Fasteners, machine for making steel, G. L. Crouse 863,155
Fastening device, W. D. Forsyth 862,898
Fat and other substances, machine for cutting, E. E. Motter 862,027
Faucet, G. C. Brown 862,879
Feed water regulator, R. Manning 863,299
Feeding mechanism, A. Shedlock 863,105
Feeding trough, measuring stock, J. E. Kirstein 863,071
Fence fabric, wire, W. Grimm 863,060
Fence gate, A. L. Weston 863,244
Fence post, C. H. Myers 862,928
Fence post, cement, J. G. Trimble 863,118
Fiddle, E. M. Wood 863,246
File, flexible, H. E. Harkin 863,386
File, paper, C. Spiro 863,462
Fire cracker, N. Del Grande 863,514
Fire escape, J. M. Roach 863,222
Fireproof buildings, floor and ceiling construction for, L. Hermann 862,911
Fireproof partition, H. G. Pfost 863,088
Fish hook, A. Mern 863,078
Fish hook, V. Gebhardt 863,272
Fitting table for dressmakers, etc., E. C. Dailey 863,512
Floor rubber, C. O. Quimby 863,220
Floor set, C. L. Hopkins 863,394
Fluid cooler, A. R. & F. S. Welch 863,337
Fluid pressure regulator, L. B. Fulton 863,528
Fluids, rate regulating device for, F. N. Connet 863,264
Fly catching appliance, H. Moss 863,038
Fodder tie, C. W. Buell 863,018
Folding box, J. Ewald 863,521
Frame. See Carrier frame.
Fruit and vegetable cutter and slicer, H. Smithson 863,110
Fruit picker, E. Gier 863,380
Fuel process and production, artificial, P. Grayson 863,028
Furnace, O. Trossin 863,239
Furnaces for producing carbid from lime and carbon, charging electric, A. J. Petersson 863,044
Furnaces, water cooled stirring shaft for roasting, W. J. Becker 863,139
Furnaces, water cooled stirring shaft for roasting, Becker & Pattis 863,140
Fuse strips of safety fuses, making complete, F. D. Reynolds 862,938
Game apparatus, G. W. Windle 863,245
Garment hanger, J. Scholl 863,100
Garment hanger, J. P. Sundin 863,236
Garment stiffener, H. Feder 863,371
Garment supporter, E. M. Degenhart 863,150
Garment supporter, G. Martin 863,548
Garter, C. Armat 862,957
Gas engine, H. Stoltenberg 863,234
Gas generator, V. Sepulchre 863,323
Gas generator, J. Ainsworth 863,487
Gases in burning buildings, vent for the escape of combustion, J. Elmer 863,059
Gases, purifying hydrochloric acid, W. Hasenbach 862,906
Gate, C. Siebring 863,231
Gate, R. M. Thompson 863,471
Gear, transmission, J. H. Richards 863,317
Gearing, A. F. Victor 863,120
Gearing, change speed, S. Bramley-Moore.. 863,145
Gearing, friction, R. & J. Gawron 863,376
Girder, trussed, J. Kahn 862,973
Glass cutter, V. F. Reich 863,316
Glass drawing machines, regulating device for, L. A. Milliron 863,200
Grain huller, P. Kerr, et al 862,975
Grate, E. J. Hoffman 862,915
Grave marker, imperishable, J. W. Brownsberger 863,354
Grinding machine, H. Born 863,359
Grinding mill, L. Holland-Letz 863,066
Gun, automatic, A. W. Schwarzlose 863,101
Gun barrel, T. A. Parker 863,431
Gun house and the like, R. A. Hadfield 863,063
Gyratory crusher, H. I. Keen 863,284
Hair comb, H. Cooley 863,510
Hame fastener, Eldridge & Willers 863,162
Hand brace, O. Granum 863,384
Harness for orchard and vineyard use, Lampson & Warren 863,288
Harness pad, E. Lecuyer 863,542
Harness strap keeper, J. C. Earnest 863,519
Hat blocking apparatus, E. Garner 863,375
Hay press, P. W. Moore 863,302
Hay press, J. C. Gamell, et al 863,374
Hay rake, L. J. Lindsay 863,192
Head harness, athletic, G. L. Pierce 863,315
Heat regulator, G. W. Hagaman 862,966
Heater and radiator, combination, C. Schaefer 863,318
Heating element, electric, G. J. Schneider.. 863,454
Heating system, A. G. Paul 863,211
Heating system, W. H. Bright 863,504
Hinge, C. J. Aebi 863,128
Hinge, W. P. Angelo 863,132
Hinge, awning blind, A. Swisher 863,465
Hinge, detachable, E. E. Rice 863,221
Hoist, J. H. Clark 863,152
Hoist, Beebe & Trimble 863,345
Hoisting apparatus, L. Moss 863,203
Hoisting apparatus, D. O. Pritchard 863,441
Hoisting apparatus and transporting means therefor, F. Sandwisch 863,098
Hoof pad, M. Hallanan 863,386
Horse boot, M. Weiss 863,336
Horse grooming implement, A. H. Blanchard 863,257
Horse releaser, G. E. Petterson 863,437
Hot air furnace, G. W. Crawford 863,361
Hot air register, Morgan & Whitcomb 863,037
Hub attaching device, W. E. Faulkingham 862,890
Hub, automatic coaster and brake, C. Newton 863,422
Hub, two-speed and automatic coaster and brake, Newton & Brown ..... 863,423 to 863,426
Huller. See Grain huller.
Ice cracker, Harrington & Thorn 863,390
Ice cream can, J. J. Snigo 863,559
Illumination, device for effecting, G. F. Kunz 863,287
Illusion apparatus, J. R. Lancaster 863,407
Illusion apparatus, F. D. Thomas 863,470
Implement rack, W. H. Smith 863,005
Incubators, thermometer attachment for, T. W. Bickel 863,500
Indicator, T. Eynon 862,889
Induction coil, J. O. Heinze, Jr. 863,175
Induction coils, apparatus for winding, C. A. Pfanstiehl 862,935
Instruments in adjusted positions, device for maintaining, A. Maul 863,035
Ironing board, E. W. Roe 862,941
Ironing board, Busch & Purcell 863,150
Ironing board chair, M. J. Herbert 862,970
Ironing pad, J. E. Church 863,507
Japanning apparatus, automatic, D. F. Broderick 863,147
Journal box, A. Byrd 862,880
Journal box lid, J. W. Stephenson 863,560
Key ring, J. Lynn 863,297
Knitting machine, wire fabric, I. J. Young 863,482
Knob, door, J. T. Henderson 863,176
Labeling machine, box, G. E. Inman 863,089
Ladder, extension, S. C. Johnston 862,971
Lamp, W. S. Hamm 863,388
Lamp burner, G. W. Gibbs 863,379
Lamp chimney holder, H. F. Gleason 862,900
Lamp, electric arc, R. T. Felsch 863,568
Lamp for melting sealing wax, H. Straube. 863,464
Lamp, gas, A. H. Humphrey 863,182
Lamp hoisting device, electric arc, J. Neu. 863,041
Lamp receptacle to a support, means for securing an electric, R. P. Schriver 863,320
Lamp shade, Holt & Foster 863,178
Lamp shade, incandescent, H. D'Olier, Jr.. 862,965
Lasts, socket securing device for, H. J. Jaquith 863,184
Lasts, stick for supporting shoe, W. Crossley 862,885
Latch, A. W. Chick 863,262
Latch hook, E. A. Hill 862,914
Lathes, sanding attachment for wood-turning, M. H. Sheridan 863,228
Lawn sweeper, W. Blalock 863,256
Letter, figure and the like in relief, J. Fischer 863,523
Lifting jack and truck, combined, I. P. Nelson, et al 863,421
Liquid weighing apparatus, W. Leinert 863,032
Liquids, apparatus for treating foaming, F. H. Lehnert 863,031
Loading and unloading apparatus, C. A. Long 863,075
Locomotive boiler and steam superheater, H. H. Vaughan 863,333
Loom for weaving double pile fabrics, A. Heald 862,908
Loom warp stop motion, G. B. Ambler 863,130
Loom warp stop motion, W. F. Andrews ... 863,131
Lubricating bearings, W. M. Coffman 863,153
Mail bag catcher, T. E. Sheffey 863,326
Mallet, C. Knopf 863,404
Manure spreader, B. B. Miller 863,550
Massage apparatus, S. F. Bowser 863,143
Massage device, flexible, S. F. Bowser 863,144
Matches, safety device for the ignition of show, F. Kammler 862,974
Matting, G. B. Dickerson 863,054
Mausoleum, T. J. Moore 863,303
Measuring instrument, electrical, W. E. Sumpner 863,006
Measuring instrument indicator, electrical, Simpson & Price 863,109
Measuring stick, J. O'Bryan 863,300
Mechanical movement, E. Oehrle 863,430
Mechanic's furnace, C. Bargamin 862,958
Metal chips, treating, S. Axelrod 863,134
Metal, expanded, W. D. Forsyth 862,897
Metal pouring apparatus, Thill & Klepinger 863,409
Metal structure, J. A. Wolle 862,956
Metal tie and rail fastener, J. I. Shaw 863,458
Metallic tie and rail fastener, J. L. Hickle 862,912
Miner's drill, E. Clark 863,508
Mirror, hand, C. K. Decherd 863,304
Mop, F. S. Thomas 863,561
Motor. See Car motor.
Motor control, C. B. Laraclere 863,188
Motor meter, electricity, G. Hookham 862,916
Mower, lawn, O. O. Riswold 863,557
Mucking machine, F. W. Durfee 863,368
Muffler, E. T. Alber 863,342
Night soil reduction plant, P. E. McDonnell, Jr. 863,305
Oil burner, J. D. McCord 863,304
Oil cabinet, H. T. Satterlee 862,999
Ore feeder, G. B. Shipley 863,229
Ores, treating, B. McKnight 862,987
Ores, treating vanadium, F. de Lucio 863,076
Organ, wind chests, means for automatically controlling the supply of air to, J. M. Rosenblatt 863,450
Overshoe, H. Mets 863,549
Packing, Nash & Briggs 863,205
Packing bin for fruit, etc., adjustable, Mathers & Stevens 863,572
Packing, piston rod, L. H. Martell 863,190
Packing, rod, O. J. Garlock 862,899
Packing, sectional metallic, E. W. Tucker. 862,940
Packing valve rods or shafts under pressure, means for, Leib & Witte 863,409
Padlock, P. D'Angelo 863,053
Paint compound, A. A. Eberson 862,888
Paper feeding machine, W. Scott 863,521
Paper tube machines, cut-off mechanism for, F. C. Osborn 863,208
Pavement, H. J. Rufli 863,086
Peat, preparing, C. U. Greeley 863,385
Pen cap clip, J. A. Holland 863,029
Pencil, C. W. Boman 863,258
Pencil, lead, E. Winne 862,955
Pencils, rubber tip for lead, F. McIntyre.. 863,306
Permutation lock, C. E. Leighton 863,292
Photograph holder, W. H. Stevens 863,114
Planing mill roll for, D. R. Greene 863,167
Picture film, moving, Bensinger & Euller.. 863,141
Picture machines, governor controlled safety shutter for moving, F. G. Dustin 863,517
Pile case or former, collapsible, Bilyeu & Hirstel 863,016
Pillars, machine for ornamenting turned, J. Anderson 863,492
Pin protector, K. E. Johansson 862,920
Pipe cap, electric installation, W. H. Vibber 863,334
Pipe coupling, J. H. Phillips, Jr. 862,994
Pipe coupling, W. W. Gordon 863,027
Pipe laying, device for facilitating, J. F. Jones 862,972
Pipe locking attachment, smoke, G. L. Shead 863,325
Pipe or hose coupling, J. H. Phillips, Jr.. 862,995
Pipe wrench, chain, Brocksieb & Tognazzini 863,017
Pistol, pop, W. Jerger 863,400
Planing machine, wood, I. J. Budlong 863,505
Plow and cultivator, combined, W. P. La Follette 862,977
Plow draft mechanism, G. E. Gowey, et al. 863,373
Plumb and level, S. C. Matthews 863,416
Pneumatic dispatch tube carrier, M. C. Schwab 863,456
Pneumatic drill, F. Hart 862,905
Pocket, garment, J. Oleschak 862,992
Poke, hog, T. L. Douglass 863,057
Police leader, J. Malcolm 863,298
Polishing rod grip, L. A. Smithson 863,461
Portable elevator, J. Beach 862,874
Prepayment mechanism, E. Schattner, 863,046, 863,225
Printing press gage, L. B. Odell 863,311
Projectile, C. De Zafra 863,248
Pulley, H. T. Hallowell 863,391
Pulley, metal, H. T. Hallowell 863,387
Pump, rotary, J. Clark 863,022
Pump, rotary, M. F. Abbe 863,250
Pump valve mechanism, D. Sheen 863,107
Pumping and drilling machine, W. G. Blaisdell 863,255
Punching and shearing machine, W. McKee 863,204
Punching machine, B. F. Berry 863,346
Puzzle or game apparatus, H. Macrum 863,412
Rail bond, M. Hawkins 863,551
Rail chair, E. A. Gilchrist 863,381
Rail connection, switch, M. Waters 862,950
Rail coupling device, J. W. Gee 863,378
Rail joint, C. J. Heiser 863,392
Railway block signal, Shannon & Wood 863,102
Railway cattle guard, Wagner & Wiseman.. 863,241
Railway purposes, electromagnetic apparatus for, L. H. Thulien 863,332
Railway rail chair, M. L. Dunham 863,367
Railway rails, means to prevent the spreading of, J. A. Shires 863,558
Railway signal, W. W. Brown 863,148
Railway signal, Mucci & Celenza 863,418
Railway signal device, J. A. Baker 863,495
Railway signal mechanism, J. F. Coleman. 863,263
Railway signaling system, electric, C. M. Cleaviand 863,509
Railway switch, B. J. Morgan 863,416
Railway switch operating device, street, R. M. & J. M. Van Eaton 863,475
Railway switch stand, W. J. Brittain 863,050
Railway switches and signals, machine for controlling power operated apparatus connected with, J. D. Taylor 863,237
Railway tie, C. A. Damron 863,052
Rakes. See Hay rake.
Raker gage and jointer, J. C. Gehrman 863,377
Ratchet wrench, P. H. Lasley 863,408
Receipt marker, H. C. Busby 863,019
Recording device, C. L. Jaeger 863,281
Reducing compounds and producing low-carbon ferro alloys, E. F. Price 862,996
Register or name board, F. W. Leuthesser 863,295
Regulator and safety stop, J. Tribe 863,117
Ride construction, C. Hamilton 863,171
Rivet, headless, E. B. Stimpson 863,330
Rivet, split, E. B. Stimpson 863,463
Roasting furnace, W. A. Rankin 863,045
Roasting furnace, G. E. Kirk 863,187
Rock breaker, J. B. Freeman 863,526
Rolling machine, A. Shedlock 863,103
Rope clamp, D. S. Kranch 862,922
Rotary engine, Lee & Nelson 863,191
Rotary engine, J. H. Setser 863,524
Rotary engine, L. S. Flatau 863,524
Rotary engine, compound, M. B. Erickson.. 863,520
Rotary motor operated by gas or hydrocarbons, M. J. Burlat, et al 863,355
Rubber tubes, self-closing clasp or cock for, G. Ivanoff 863,398
Sad iron, electric, G. J. Schneider 863,455
Safety drill and tap holder, E. Groom 862,901
Sail furling means, H. Ragener 863,444
Sand wheel, W. H. Hobby 863,276
Sash fastener, W. G. Schneider 863,226
Sash frame and sash, J. G. Roseboom 863,063
Sash, window, W. Le Quesne 863,294
Saw clamp and set, combined, F. H. Turner 863,562
Sawing machine, F. Anderson 863,041
Sawing machine, wood, T. L. Curtright 862,886
Scale, computing, T. C. Prouty 862,937
Screw, Jackson & Burnett 863,183
Screw threading machine, J. O. Dizon 863,515
Seal, automatic, A. C. Rosenbrook 863,004
Seal lock, L. B. Edgar 863,025
Separating the more soluble constituents of a material from the less soluble constituents thereof, T. Griswold, Jr. 863,061
Separating the more soluble constituents of a material from the less soluble constituents thereof, means for use in, T. Griswold, Jr. 863,168
Separator, C. M. Lauritzen 863,180
Sewage ejecting system, J. W. Cooney 863,260
Sewer cleaning apparatus, J. F. Kuhlman. 863,073
Sewing machine feeding mechanism, M. Hemleb 863,532
Sewing machine looper mechanism, W. M. Ammerman 863,490
Sewing machine stitch forming mechanism, W. M. Ammerman 863,489
Sewing machine stop motion device, E. B. Allen 863,129
Sewing machine throat plate fastening, W. M. Ammerman 863,491
Shade hanging device, window, Terry & White 863,468
Sharpers or planers, work holder for, M. & H. E. Morton 862,924
Sharpener, disk, L. D. Toliver 863,473
Sharpening apparatus, saw, C. H. Reynolds 863,446
Sharpening instrument, cutlery, A. Rademacher 863,443
Shearing machine, J. J. Vallere 862,949
Sheet delivery mechanism, smut sheet attachment for, R. Miehle 863,090
Sheet folding and other machines, cutter mechanism for, C. A. Sturtevant 863,007
Shell grinding machine, N. Barry, et al 863,499
Shock loader, W. Peltier 863,042
Shoe polishing machine, J. A. Brewer 863,502
Shoe string fastener, H. Behrens 862,875
Sight feed fountain, C. C. Hill 862,913
Signal device, safety, M. Salmond 863,452
Signal mechanism, E. E. Flora 863,569
Signaling device, electric, J. A. Baker 863,252
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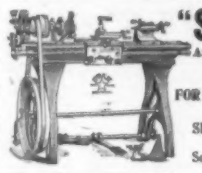

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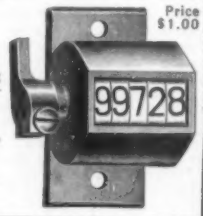

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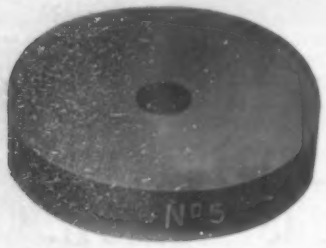

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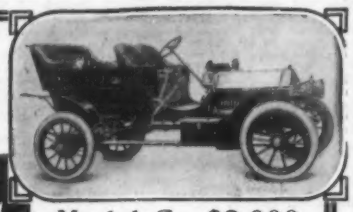

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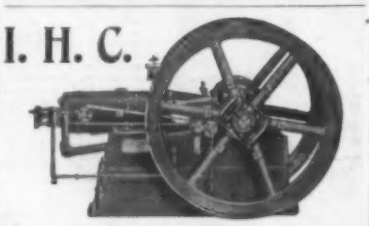

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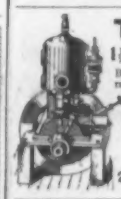

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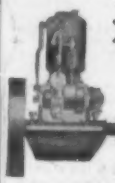

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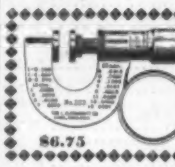

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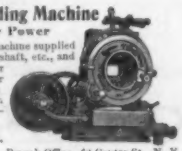

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